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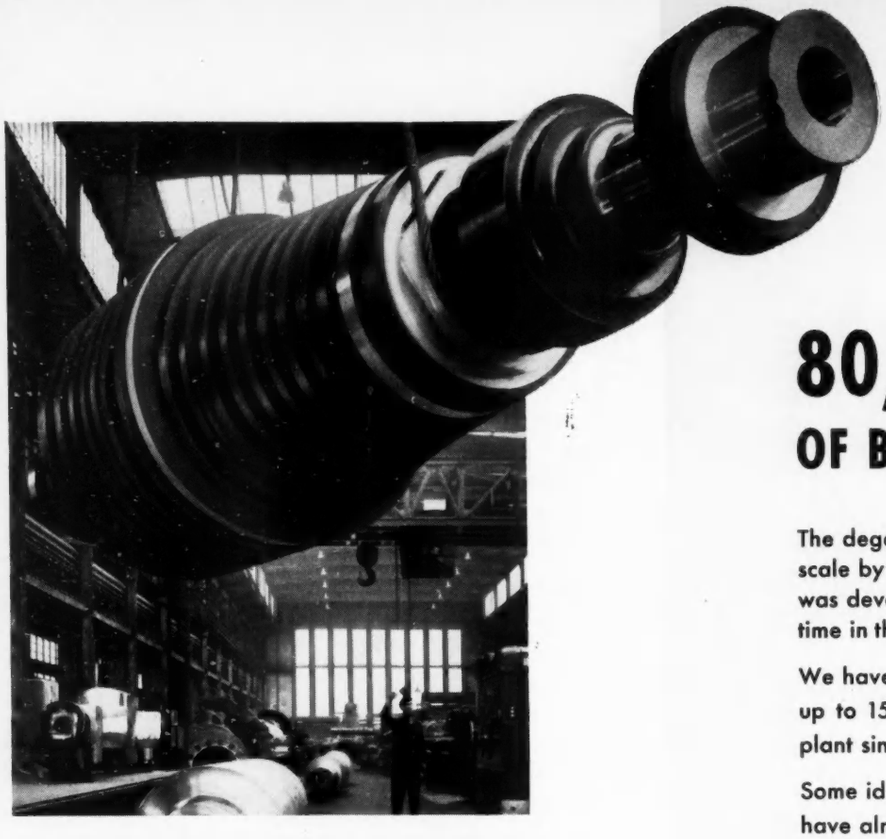

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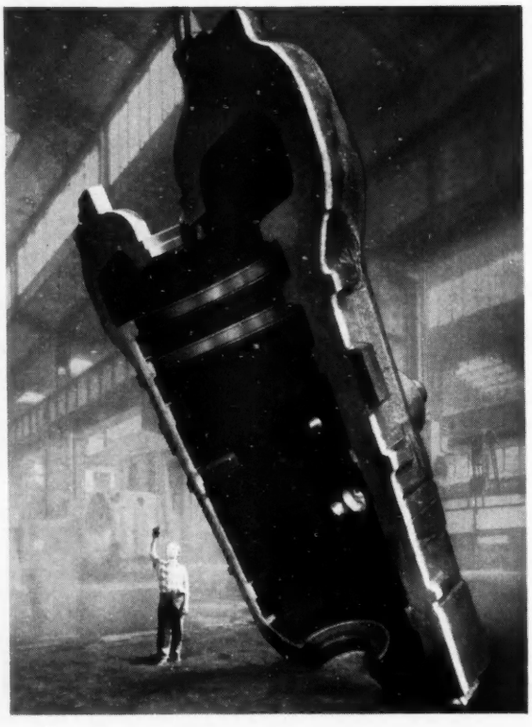

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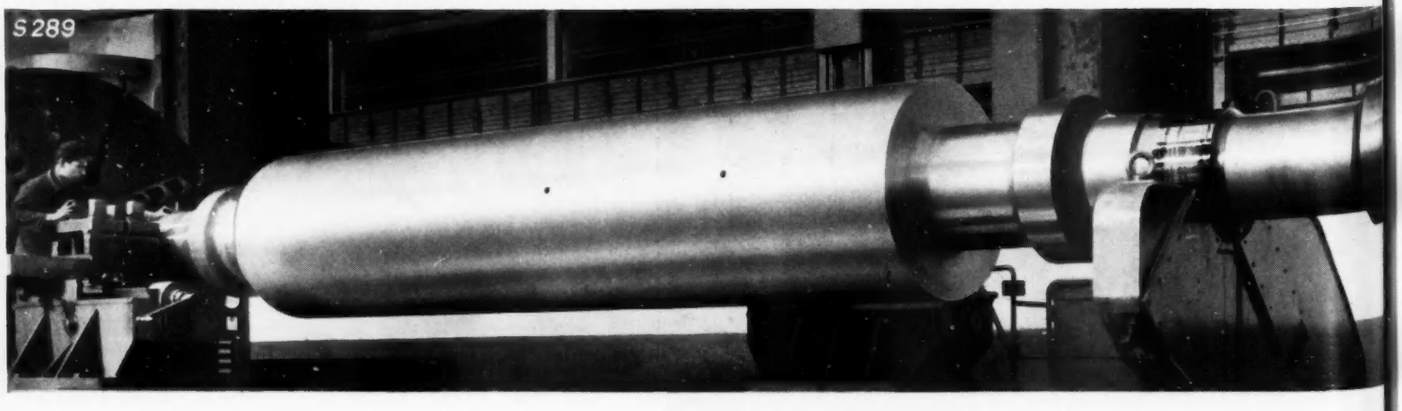

ENGINEERING

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Food Programming

FOOD is the most fundamental of our resources. We organise our other industries in a systematic and efficient manner: oil and chemicals are extracted, processed and distributed in optimum conditions; engineering goods are made with the greatest thrift in effort and materials. But food, perishable and indispensable, is handled in prodigal and haphazard fashion. In spite of remarkable developments in scientific farming and hygienic distribution, the overall pattern of food supply remains fragmentary and uncoordinated.

This confusion is hardly surprising. Food is not a single problem. From agriculturalist to dietician, from the questions of famine and undernourishment to the subtler distinctions of master chef and gourmet, the subject is a shifting complex of contradictory interests and specialities. Who, then, is equipped to assume an overall responsibility?

By taking a typical cross-section of the processes involved it may be possible to ascertain the common factors of food production. A typical selection might include ploughing, sowing, milking, milling, processing, preserving, pasteurising, packaging, canning, distributing and vending. Today each of these processes includes an element of engineering, from ploughing, which is essentially an earth-moving operation, to vending, which is increasingly performed by automatic machines.

Two exhibitions are being held in the coming week, both associated with food. The International Bakers' and Confectioners' Exhibition will show how thoroughly the modern bakery has taken up the methods of mass production; the Frozen Foods and Quick Freezing Exhibition will demonstrate how dependent we have become on the refrigeration engineer. The Dairy Show, later this month, and the Smithfield Show and Agricultural Machinery Exhibition, early in December, will both be dominated by engineering. The recent Packaging and Food, Cooking and Catering Trades Exhibitions showed a similar preponderance.

A booklet issued recently by the Stainless Steel Manufacturers' Association makes clear the extent to which the dairyman has mechanised. His pasteurising plant, comprising a continuous-process plate heat exchanger, holds the milk for a few seconds at a given temperature with such accuracy that the cream line and taste are virtually unaffected. A group of engineering companies claim that by using aerodynamic principles in the design of forage harvesters, they have cut power consumption by half. Machines for picking hops have also been developed. The Soviet plan to make millions of barren acres fertile by diverting rivers at present flowing into the Caspian, Baltic and Arctic seas and the work of the Tennessee Valley Authority illustrate the contribution of civil engineers. Even barbed wire has helped to make the earth more fruitful.

In the future, engineering is likely to play an even greater part in food production. Already a British firm has demonstrated a pilot plant which produces edible protein from plants. The process uses impulses to break down the cell walls while leaving the contents unemulsified and hence amenable to separation. A " motorised milking cow " has been installed in a Swedish ship and is designed to provide fresh milk at sea by recombining water, skim milk and butter; while in America an as yet unpalatable and costly milk has been produced directly from grass without the intervention of a cow. A milk pipeline is to be built in Italy, though so far no " milk grid " is envisaged.

Sea farming, instead of sea hunting, is another considerable prospect for the future: in a Scottish loch fertilised with superphosphate, the fish were found to grow bigger and faster. There is also the whole province of synthetic food: sugar has been made from wood, and during the war the Germans made margarine from coal.

Clearly engineering has infiltrated the food industry to such an extent that it has taken the place of agriculture as the predominating element. Engineering can make an even greater contribution. System is the key to engineering and it is lack of system that causes so much waste in present food administration. For its own purposes, engineering has created operational research; now the same methods can be applied to the administration of food. Take, for example, the feeding power of an acre. Under potatoes an acre could support three times as many people as an acre under wheat. Neglecting, for simplicity, the variation in soil quality, but bearing in mind the danger of a single-crop economy, it should be possible, with a computer, to calculate the optimum crop-acre balance. The procedure might be analogous to the linear programming technique used in petroleum refineries to estimate the optimum selection of different fractions for a given situation.

Sir Charles Darwin has often threatened that our geometrically increasing population will lead to limitation by starvation. Lord Boyd Orr has stated that the earth could support three times its present population. No crumb or morsel of our loaves and fishes can we afford to waste.

Cover Picture.—*The portal frames are made of laminated timbers glued with resorcinol resins. One branch of the divided column will form a main beam inside the building, the other a short cantilever supporting an overhanging upper storey. In the finished building, the frames are exposed as a major architectural feature.*

Plain Words

It is well known that in the Army you are sent on courses to learn skills which you are never required to use on active service, and on active service you find yourself responsible for jobs which you didn't know existed. In civilian life I have found the same perverse situation; I was taught many things which are now quite useless, and the two big lessons I have had to learn could not be taught.

Engineers inherit a tradition of pride in the ability to tackle anything, however unfamiliar. It is a matter of professional honour never to be flummoxed. If the brigadier says he wants a brigade of tanks ferried across the widest river in Europe, and the Sappers have no equipment to offer, or the chairman says the company's stand at the forthcoming exhibition must display the prototype of a machine which you have hardly thought of but your competitor is already testing, then you must set to and find the answer, if only to prove that you are a real engineer.

That is a fine tradition, but it is dangerous if it induces—as it often does—an unwillingness to admit ignorance, and a positive aversion to calling in specialists. It took me far too long to learn this lesson. I suffered under the delusion that there must be a finite body of engineering knowledge and that so long as I was studying my profession it was up to me to acquire it. After I had knocked about a bit I began to realise that other engineers had knowledge and experience that I could never hope to acquire. I also discovered that the best way to learn from others is to admit ignorance of their speciality and be ready to listen to them. Everyone likes to talk about his work.

The other experience for which most of us are totally unprepared is the bitter humiliation of seeing a child of our brain fail or break down in front of people we had hoped to impress. Every test we can think of has been carried out, all the teething troubles seem to have been eliminated, all the cynics can now be silenced; the big day has arrived and fresh support to continue is just round the corner. And then the silliest, quite unimportant thing puts a spoke in the wheel. When that first happened to me I was powerless to convince the authorities that in spite of the setback, the principle was sound; most of the authorities, as it happened, were miles away and unknown to me. I couldn't reach them, and they stopped the work.

I learnt then that the greatest test of an engineer is not his technical ingenuity but his ability to persuade those in power who do not want to be persuaded, and convince those for whom the evidence of their eyes is anything but convincing.

CAPRICORN

Weekly Survey

Wages Arguments Differ

The unions in the engineering industry have fired their wage claims as from a double barrelled shotgun—one for the engineering employers federation and one for the shipbuilders. Last month the claims went in and two distinctly different noises were heard.

Presenting the engineering employers with a demand for a £1 a week more and a four hour cut in the working week, to 40 hours, Mr. W. J. Carron, president of the Amalgamated Engineering Union, welcomed the stability in the cost of living. This was the time, he argued, for an advance in real wages, which had not kept up with productivity. The next day the outspoken Mr. E. J. Hill, secretary of the boilermakers' society, asked the shipbuilding employers for "a substantial wage increase" and a 40 hour week.

The differing note came in his arguments. The unions, said Mr. Hill, echoing many a doorstep election canvasser, did not regard stability in the price index as at all the same thing as stability in what it cost their members to live. Until this year's budget cut the cost of beer, price increases had gone on more or less unchecked since 1947. But then, having opened the battle out of step with his fellow general, Mr. Hill got across his own lines, declaring: "With prices steady, we now clearly state our demand for an increase in the real value of the basic wage rate."

The two-part nature of the claim is the outcome of aspirations and fears back in the branches that are many more than twofold. There is not only Mr. Carron's massive assembly of facts and figures, to which the employers will reply in mid-November—and what they will reply may be guessed since granting the claims in full and working on at the present 44 hour week would cost the engineering industry £420 million a year—there is also the potent effect on the man in the works of the times in which he is living. On the posters, on the air, in his newspapers he sees and hears the shining proclamations of the politicians and the ad-men: he has never had it so good and the future will be even better. It is hard to see how the blaring of all the buy-more consumer advertising, and the recital of washing machine statistics in election speeches, can fail to put steam behind wage demands.

And if active hopes are there so are the not so dormant fears. Automation at home, fluctuations in foreign trade, reports of a widening lead in some Russian manufacturing methods, these are a few of the causes experienced union men say lie behind the hours claim, with its first-sight appeal of "spreading the work around." That a sharp increase in British export prices, and not only of engineering products, might do more damage to employment and earning, than any or all of these, is less often discussed.

Food Mechanics

No-one who has stood in a country lane and seen two combine harvesters gathering the yield from a single field and then turned into the village shop and found a third of its floor space taken up with a refrigerated cabinet of frozen food packs can doubt that the food industry is more and more mechanised, right from the autumn ploughing to the breakfast table.

Most rapidly developing of all have been the last links with the consumer. The frozen food supply, in a dozen different departments of the grocers' store, is perhaps most obvious to the public. All this is to be celebrated at the Frozen Foods and Quick-Freezing Exhibition and Convention at the Old Hall of the Royal Horticultural Society, Westminster, for three days from Tuesday, 6 October. While the National Research Development Corporation will not be able to show the quick-freezing process at the heart of its important new system by which fresh milk can be frozen for long storage without being impaired in flavour or being homogenised, the NRDC will show a pilot tank and generator demonstrating the principle of putting the ultrasonic waves through the milk preparatory to quick-freezing.

Refrigerated transport, vending machines and other equipment will be on show, illustrating further fields where the engineer is in the van of the fast changing world of food habits. The great export potential here has been strongly emphasised by the multi-million pound orders executed in dairy machinery for the Russians by Uni-Gate.

Ripple on the Clyde

Speaking to the Glasgow Chamber of Commerce on a visit to the Scottish Industries Exhibition, Sir David Eccles, President of the Board of Trade, returned once more to the Government's determination to make some major changes in the legislation controlling assistance to development areas. Sir David pointed out the amount of diversification of industry which had been effected by local enterprise especially through the Scottish Industrial Estates. These estates have today 16 million sq. ft of industrial space financed by the Board of Trade and giving employment to 66,000 people. There is in hand a programme for a further 1·2 million sq. ft, giving employment to a further 4,000.

No matter how much encouragement industry may have by means of grants and directions to go to areas of higher unemployment, in the end success for diversification in areas dependent on heavy industry must rest on local, active co-operation. It so happened that a good example of this was reaching an advanced stage on Clydeside while Sir David was speaking. A few days after his address the Inchgreen Investigating Company announced that the proposed £4¼ million graving dock on the Clyde at Greenock had made considerable progress at the negotiating stage. Final financial and technical details have still to be arranged but it is hoped to put out tenders within the next few months and to begin construction by autumn of next year. It is known that the Treasury has agreed to provide a loan of two-thirds of the total at a rate of interest still to be announced provided local private enterprise would put up the balance of the money in the form of equity shares. It is now known that a number of leading shipbuilding and engineering companies on Clydeside are supporting the scheme and that certain facilities will be made available by the Scottish banks. Companies taking an interest include John Brown, Lithgows, Charles Connell, Fairfield Shipbuilding and Engineering, William Hamilton, John G. Kincaid Scott's Shipbuilding and Engineering, and the Greenock Dockyard Company. Support has also been received from Colvilles, G. and J. Weir and from Sir Ian Stewart, chairman of Thermotank.

Ulster Raises its Bid

In the recent recession the unemployment percentage in Northern Ireland was one of the worst in the country. This came as a reminder that the development of new industries in Ulster is a long term undertaking and that, as has been found in other areas such as South Wales and Scotland, a good deal of publicity and hard organisational work is necessary to achieve modest results. In the case of Ulster there is the

additional barrier, which is probably as much psychological as physical, of the Irish sea and this difficulty will take time to overcome.

The Northern Ireland Development Council, with the Northern Ireland Government in the background, is therefore wise to emphasise the improved transport facilities at Belfast. It has been known for some time by British industry (and a number of big companies from this country and from the United States have taken advantage of it) that factory space and capital grants were available for new enterprises settling in Ulster but the new installations by the Belfast Harbour Board and the Larne Harbour Company should be particularly valuable in breaking down the reluctance of companies to establish factories separated from them by a sea passage.

Advertising the Professions ?

By one of those pleasant coincidences peculiar to real life, in the same week that Sir Sydney Littlewood, president of the Law Society, was asking its annual meeting why it should hesitate to advertise, the British Institute of Management was reiterating, by public announcement, that its member firms of management and industrial consultants firmly believe that they must not advertise their services.

At a second reading it appears the two positions may not be far apart. To solicitors individual advertising is well known to be repugnant but what Sir Sydney was considering was the benefit to the public and the profession if the society were publicly to describe in what way a solicitor is able to assist the citizen in his increasingly complex affairs.

By the public statement of its code the British Institute of Management of course publicises the existence of the register of consultants in a way helpful to industry, to consultants and also to their good name. The struggle against the past doubtful associations—often linked with the scornful use of the phrase " efficiency expert " —is now a long way on towards success but the institute rightly feels a need for caution.

One result of the institute's announcement has been a number of inquiries to its registrar from individuals interested in making use of a consultant's advice. In general new clients come to consultants, as indeed to solicitors, by personal recommendation. At a recent informal meeting one of the best known industrial consultants in the country said that almost 70 per cent of his new business came through recommendations.

There is an important distinction in the problem. Undoubtedly some solicitors feel that work they should do is in some cases being done by others. For the management consultants it is a matter of consolidating and maintaining their good name.

The outline, in brief, of the management consultants in Britain is that they number some 1,500 individuals, of whom 1,200 are bound by the code of the institute. They are widely used among the larger firms and the growth of the profession is seen as coming from the greater use of their services by smaller companies. Hard travelling, not only in this country but abroad, and dollar earning at times, their unique contribution is detachment from the clients' routine and freedom from concern in what is well called " office politics."

Railways Pick Up Slowly

According to figures issued by the British Transport Commission, in the four weeks ended 9 August the railways carried 5·5 per cent more merchandise than in the same period a year ago. The previous four week period had seen an increase of 2 per cent. The better performance is due partly to the general industrial recovery and partly to the railway modernisation programme. It's noticeable, however, that the state of general industrial activity is the main factor at the moment. For example, the improved figures for merchandise, which includes a bigger volume of steel freight is more than offset by the poor receipts from coal and coke. Receipts from these last were 11 per cent lower in the four weeks to 9 August than a year before.

Competition for traffic and the new method of charging is causing freight receipts to grow more slowly than the increase in tonnage of merchandise carried. In the four weeks ended 6 September total rail freight traffic produced £21·5 million which was about £1 million or 4·4 per cent lower on the year. Over the first 36 weeks of the year, total receipts were down by £18 million to £206 million. It is apparent that modernisation of the railways and the new rate structure will do little more between them over the next few months on the most optimistic assumptions than make a modest contribution to closing the railway deficit in 1959. The hope of a better performance financially by the railways this year depends on a sudden recovery in the movement of coal, coke and heavy merchandise. There is some prospect of a modest improvement thanks to the recovery in the steel industry but it is not likely to be of sufficiently large proportions to prevent the railways from incurring a substantial deficit again this year.

World Bank Meeting

One of the most important subjects before the annual meetings of the World Bank, being held in Washington, is the proposal of the United States governor that consideration should be given to setting up an International Development Association to arrange the money for economic advancement. With Mr. Khrushchev over the American doorstep and proclaiming intensive competition in every direction the World Bank cannot too urgently give its attention to the needs of the underdeveloped countries.

The Washington meetings are threefold. The International Bank for Reconstruction and Development, the International Monetary Fund and the International Finance Corporation.

The Bank has sent to Venezuela a mission to survey the economy and, at the government's request, to assist in the formulation of a programme of economic development. Starting work last month, the mission should complete its work about the turn of the year. The 12 member team is led by a former director of the United Nations relief and works agency for Palestine refugees, Mr. Henry R. Labouisse. The International Labour Office provided the team with an industrial economist.

Pump Priming in Argentina

The first of the United Nations Special Fund projects to get under way, a £90,000 survey of Argentina's power needs and the possible technical answers, goes straight to the heart of that country's economic problem.

A serious shortage of power has held Argentina back from industrial and economic expansion and it is to an investment of " many millions of dollars " in power, that Mr. Paul G. Hoffman, managing director of the special fund, looks in his announcement of the agreement on the project. The money is being put up by a number of United Nations members and Argentina will herself be putting in useful amounts of local capital. For the future Mr. Hoffman sees the continuation of close cooperation with the World Bank as the executing agency for the fund. The current project will assess the amount of power to be provided over the next ten years and draw up emergency and long-term programmes. The consulting firms recommended by the Bank and retained by the Argentine government are Kennedy and Donkin of London, and Tippets-Abbett-McCarthy-Stratton of New York.

Special fund projects for which approval was given earlier this year include schemes in Central America, Ghana, Thailand, Poland, Turkey, the United Arab Republic and Yugoslavia.

Letters to the Editor

VIBRATION HANDBOOK

SIR, As a member of the BICERA Torsional Vibration Panel, I was naturally very interested in your review of *A Handbook on Torsional Vibration*, published on page 69 of ENGINEERING of 21 August.

While your reviewer does full justice to many aspects of the handbook, and, in particular, to the presentation of earlier work, I think perhaps he does less than justice to the amount of new information included in the handbook and the range of experience (including marine) on which the Panel was able to draw.

Among the matter which is new, I would mention the BICERA method of calculating crankshaft stiffness, and the new formula for the prediction of vibration amplitudes. The harmonic components of gas torque for two-stroke and four-stroke cycle diesel engines are also the latest available, and cover atmospherically-charged and highly pressure-charged engines used for stationary, marine, traction, and vehicle purposes. The curves for propeller damping coefficients have not previously been available in book form. The section on viscous dampers is based on study going back to 1948, when BICERA carried out work on what is believed to be the first silicone-filled damper to be made and tested in this country.

It is true that in the handbook there is only a passing reference to computers (p.385). The usefulness of computers in work involving calculations is, however, a matter of general knowledge, and details of technique in such a rapidly developing field can be obtained more appropriately from other sources than from a handbook on torsional vibration.

Yours faithfully,
J. SMITH,
Technical Director.

Petters Limited,
Causeway Works, Staines, Middlesex.
22 September, 1959.

VIRTUAL WORK

SIR, In his letter on page 19 of your issue of 14 August, commenting on my article " Virtual Work and Complementary Energy Applied to Non-Linear Braced Frameworks," Mr. M. Gregory makes the point that " strain energy " methods are not restricted to linear structures. He is quite right in this, but he is too restrictive when he says later that " energy methods are only a means to an end; they furnish a convenient method of writing down the equations of geometrical constraint." It is well known that all hyperstatic structural problems require the solution of a sufficient number of equations of equilibrium and compatibility, but it is not as well known as it should be that the various methods of analysis can be distinguished according to the order in which the two sets of equations are assembled. In " equilibrium " methods (slope-deflection for example), we begin by ensuring compatibility ($\theta_{AB} = \theta_{AC} = \theta_{AD} = \ldots = \theta_A$) and then express the conditions of equilibrium ($\Sigma M_A = 0$); the unknowns are displacements. In " compatibility " methods (least work for example) the process is reversed. We begin by writing equations for equilibrium in terms of redundant forces and moments, go on to ensure compatibility by means of displacement calculations, and finally solve for the unknowns which, in this case, are the redundants.

Energy methods can be used to good advantage in either of these procedures: they are distinguished by their power of expressing equilibrium (Stationary Total Potential Energy, Castigliano's theorem, Part I, $\frac{\partial U}{\partial \Delta_j} = P_j$) or of finding displacements (Castigliano's theorem, Part II, $\frac{\partial U}{\partial P_j} = \Delta_j$) from which the equations of compatibility can be formed. They are further distinguished by their applicability, or otherwise, to non-linear problems; non-linear displacement

LEVEL CONTROLLER

For Liquids or Solids

THE Leveltron controller for the indication and control of the levels of liquids or solids works on the capacitance principle. It has a separate adjustment for the reset point.

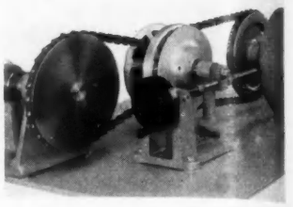
A vertical or inclined electrode projects into the tank, and the change in capacitance as the material rises or falls operates the indicator. Two controls are used. The first is for setting the control points, that is the upper and lower limits, and the second the reset points independently of the control points. This allows a simple adjustment to make the best of each application of the instrument to suit the material in use and the rate of filling or emptying of the tank. It also allows subsequent readjustment to be made after installation to accommodate any change in conditions.

The sensitivity is variable from 1 to 60 pf and the relay circuit is triggered to prevent chatter or creep. All components are conservatively rated to give long life and the instrument is arranged to fail safe. A long term sensitivity of less than 1 pf is claimed. A reversible plug allows a choice of direct or reverse acting mode of operation which also increases the flexibility of the equipment.

There are three models, a general purpose unit, a heavy industrial type and a dual control model. There is also a remote indicator unit. Remote operation is possible up to 60 yards using coaxial cable. The general purpose model has a switching capacity of 5 A at 250 V a.c. This is increased to 5 A at 440 V a.c. in the heavy industrial version, or 10 A at 250 V. *Thomas Industrial Automation Limited, Station Buildings, Altrincham, Cheshire.*

VARIABLE SPEED UNIT

Hand or Remote Control



THE Ribble infinitely variable speed unit is a belt driven gear capable of transmitting up to 2¾ h.p. It is made by Carters of Bolton.

The unit covers a range from ½ to 2¾ h.p. with an input speed of 1,440 r.p.m. The aim has been simplicity in design and operation to give a smooth stepless speed variation between the limits of the selected ratio. The control is by a handwheel or can easily be adapted for remote operation. The belts have a 40° angle and a ½ in width; either rubber or link type can be fitted with equally good performance.

The pulley diameter, which is 6½ in, covers a speed ratio of between 2 : 1 and 6 : 1, the pulleys being interlocked at all times. They are made from high tensile aluminium alloy and run on a ground spindle with oil impregnated phosphor bronze bushes fitted in the rotating sleeve.

The main base is a grey iron casting with a machined base for fixing. There are no springs in the construction and the range is fixed by two pairs of locknuts on the screwed spindle. The handwheel is made of plastics material and is screwed directly to the adjusting rod and locked with a standard lock-nut. It is simple therefore to attach a remote control using a flexible shaft or a small servo motor. Since the bearings are self-lubricating the unit requires little or no maintenance. This unit with a capacity of 2¾ h.p., is the first in the range and will probably be the smallest. It is being produced by the recently formed Power Transmission division of the company. *B. and F. Carter and Company Limited, Albion Works, Bolton.*

Continuing Letters to the Editor

calculations, for example, can be made with the aid of an equation similar to Castigliano's theorem, Part II, but using complementary instead of strain energy $\left(\frac{\partial C}{\partial \Delta_j} = \mathrm{P}_j\right)$.

Readers who are interested to pursue this matter further will find a full account of the relation between the energy theorems in an article by Dr. E. H. Brown on "The Energy Theorems of Structural Analysis" (ENGNG., 11 Mar. '55, p. 305). The present writer's book *Hyperstatic Structures* (London: Butterworth, 1959), attempts to expound the theory of statically indeterminate structures according to the principles outlined in this letter.

Yours faithfully,
J. A. L. MATHESON,
Professor of Engineering.

The University of Manchester,
Manchester 13.
21 September, 1959.

DROUGHT AND WATER SUPPLY

SIR, The sporadic water shortages have been alleged to be due to a variety of shortcomings, from undue absence of rain, lack of planning, insufficient information on demands and resources, to delay in the amalgamation of water undertakings. It might be thought that 1959 has so far been a year of drought unprecedented in the history of man. That it has been a dry summer is true, and, particularly in the north west, the driest since 1887, but the real difference between the six months summer rainfall of this year and that of the six dry summers in the last 120 years (17·5 to 21·5 per cent of the annual average) is small. We have therefore been here before.

Many recall the grave water shortages of 1921, 1929, 1933-34, 1938, 1947, 1949 and 1955, which collectively indicate the slender margins with which some water units have operated, margins which without new developments have progressively declined. It was, therefore, imprudent of Political and Economic Planning (PEP) last year and the Central Advisory Water Committee this year, to accept the principle that supply could meet demands, except in very dry years.

Whether we like it or not, man has to live with the real extremes of his climate. It is not sufficiently realised that water supply is the foundation of our health and economic wealth and that a water failure even in its incipient stages, like those experienced in a few towns in the country, endangers the very fabric of our society with its resulting septic and blocked sewers, the likely expansion of our rat population and the closure of factories. In fact man needs *more* water in drought than at any other time. Moreover, these situations discourage industry to site factories in these particular towns and the long-term damage to employment may be severe.

The fault lies in the nation's attitude to its most valuable raw material, and its reluctance to adapt itself materially to the extremes of its environment. Because of this unwillingness to open its eyes to the picture round the corner of time, depicted by its water engineers, and its belief that water as rain is a nuisance free from heaven, any extra charge for it in pipes is regarded as iniquitous to industry and householder alike. Thus, when increases in demand have doubled those of prewar days and funds should have been accumulated to cushion the cost of new works, many units find themselves financially in the red. And no one who is serious in debt can contemplate great expenditure.

Your article "Water Supplies Fail the Nation," on page 250 of your issue of 25 September, suggests that the problem is the familiar one of diminishing returns, and that more money spent can give greater security in times of drought. From this it may be inferred that such expenditure will only be useful once every great drought and this is the economic myth that afflicts water supply. In contrast, almost every water unit has experienced increased demands. Thus, some, which twenty years ago, could have satisfied the once-in-a-thousand-years drought, now find themselves unable to meet the once-in-ten-years drought and tomorrow they may not be able to satisfy a normal year.

Inevitably, those who have suffered the shock of this drought will rush to prepare new works. It is submitted that the cost of new works before the drought, through more rational preparation and planning is considerably less than rushed new works after the drought. Unfortunately, as a nation, when the music of drought has died down, we shall revert as before until a further drought shocks us from our lethargy.

Fortunately, there is one remedy to secure the nation from these dangerous evils. A water failure may be as serious as a dam failure, and these have almost been eliminated since the Dolgarrog disaster, by regular statutory inspections by independent civil engineers. The time has now arrived when a long predictive water audit should be made by an independent water engineer, so that the community and the nation may know clearly what lies round the corner of time and that failure to meet the future has its penalties. In order that we do not return to the great stinks of the Industrial Revolution we desperately need a Water Supply (Safety Provisions) Act, for this year is not the last drought; there are many more to come.

Yours faithfully,
DELWYN DAVIES.

Mid and South East Cheshire Water Board,
Weaverham Grange, Hartford, Cheshire.
29 September, 1959.

UNIT HEATER

THE new Thermolier heater unit is designed to operate on steam or low or high pressure hot water systems. The five models cover a range from 35,000 to 350,000 Btu per hour.

It is particularly claimed that the unit will fit in any background and the louvres are individually adjustable. They are made from sheet steel zinc plated. They are said to be silent running and the fan has been matched to the heat exchanger so that quantity and velocity of air give the maximum thermal efficiency. *Mather and Platt Limited, Park Works, Manchester 10.*

NYLON NET

A CARGO net has been made from nylon webbing in which the webs are woven with slots in them so that they can be threaded through each other to give a very strong mesh.

The slots are woven at close intervals so that a close or open mesh can be obtained as desired. There is no splicing and therefore no loss of strength. Accurate weaving prevents slippage or distortion during use. The standard slotted nylon webbing is 1¼ in wide with slots at 1 in intervals and has a breaking strain of 1 880 lb. Other sizes can be produced if desired. The net is durable and light. A 14 ft square net weighs about 25 lb but has made lifts of about 2 tons with ease. *British Nylon Spinners Limited, 68 Knightsbridge, London, SW1.*

ASPHALT PLANT

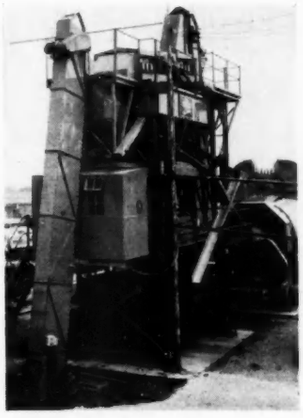
Mobile Mixing Unit

A GOOD-WIN mark 60/90 mobile asphalt plant is being used on the London to Yorkshire motorway.

The plant has four main sections for feeding, drying, screening and mixing. These are fitted with pneumatic tyred wheels for moving from site to site and air hydraulic brakes are used. Hydraulic jacklegs lift the screening and mixing sections into position. Depending on the moisture content an hourly output of up to 90 tons of mixed material can be obtained, with a total operating staff of four men.

Bitumen, sand and three sizes of granite are the materials used and once the controls have been set one man in the control room can keep the plant running. Three weigh dials measure the materials in to the plant and two push buttons control " mix " and " discharge." Each process can also be hand controlled if desired. Each finished batch weighs 3,000 lb.

A tilting trough measures the binder



to the machine and it is then fed to the RotaMixer through a spray bar over the aggregate. A hot oil circulation system keeps the binder at the correct temperature, the oil being heated by an immersion heater. *Goodwin Barsby and Company Limited, St. Margaret's Ironworks, Leicester.*

COLLAPSIBLE CONTAINERS

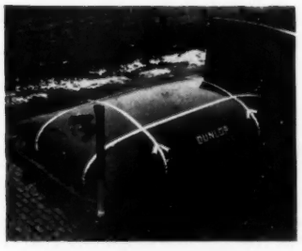
Rubberised Nylon

COLLAPSIBLE containers are now being made of rubber reinforced nylon for the carriage and storage of liquids.

The containers can be rolled up when empty and are then easy to handle and move to another site. They are made in sizes to hold up to 10,000 gallons or more.

Each container is fitted with an adaptor for a hose fitting which incorporates a non-return valve through which filling and emptying take place. The type of adaptor used can be varied to suit the customer. A small manually operated release valve allows the escape of any air introduced during filling. The liquid can be completely removed by siphoning and when necessary the container can be cleaned and sterilised by boiling water.

The use of nylon makes the containers light in weight and rotproof, together with a high degree of tensile strength. The fabric is coated on one side with



neoprene and on the other with a variety of natural or synthetic rubbers according to the liquid to be stored.

The containers can also be used for the storage of drinking water in desert areas for which purpose 50,000 gallon sizes can be made. An alternative use is as flotation bags for supporting loads over water. The illustration shows a 500 gallon container loaded on a lorry for transport. Such containers have the obvious advantage that they do not need foundations or require any time for erection at site, and can easily be moved when empty. *Dunlop Rubber Company Limited, General Rubber Goods Division, Cambridge Street, Manchester 1.*

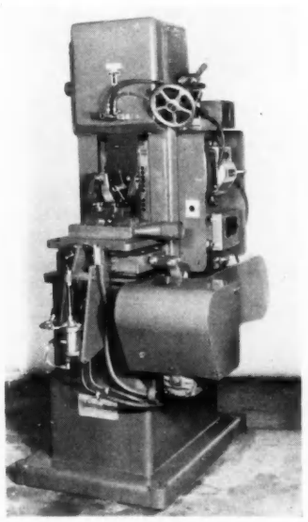
PLATEN BELT GRINDER

Oil Mist Cooling

HIGH rates of machining are claimed for the Taylor platen belt grinder which uses oil spray or mist for cooling.

The worktable oscillates across the belt to prevent uneven wear and to ensure straight line finish. The stroke can be varied from zero to 2 in and there are three speeds of operation, 68, 90 and 120 strokes per minute. The movement is mechanically operated and is driven by a separate motor. The machine incorporates an extraction system for containing the oil mist.

The operation is automatic and the control is electronic through a timing device which can be varied from 0 to 60 sec by a dial on the panel. At the completion of the cycle the table comes to rest clear of the belt. Run-out and return are rapid but the feed is adjustable to suit the material. It is limited by a dead stop. The movement is air-hydraulically operated. Belts up to 9 in wide can be used at speeds up to 7,000 ft per minute. The work area is approximaterly 9 in by 15 in. *Taylor Tools and*



Supplies Limited, Vortex Works, Atlantic Street, Broadheath, Altrincham, Cheshire.

VALVE ANALYSER

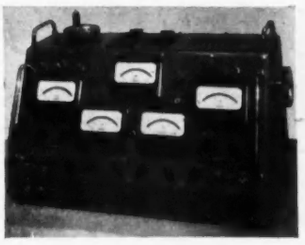
Operating Conditions Simulated

THE valve analyser type U-61B is designed as a comprehensive instrument for the detailed analysis of valves under any operating conditions.

The instrument will give characteristics of all receiving valves and low power transmitting types, and neon tube regulation curves and thyratron control characteristics may be plotted. Positive grid characteristics may also be obtained by it.

The instrument includes facilities for standard checks of filament continuity and insulation, short circuits hot or cold, cathode filament insulation and gas leaks.

Five large mirror-scale meters indicate simultaneously, heater volts, anode volts, screen volts, grid voltage and anode or screen currents. Four separate adjustable stabilised voltage sources provide the electrode voltages. Facilities are provided for the insertion of any desired elements in series or parallel with any of the electrode circuits, and



adjustable anode loads and parasitic stoppers are incorporated. A comprehensive protection system provides overload cutouts both in the a.c. supply and mains circuits.

The valve bridge type 661 which can be used independently or in conjunction with the U-61B is intended for the measurement of the dynamic as opposed to the static characteristics of the valve under test. A wide range of amplification factor, internal resistance, and slope measurements can be rapidly made for any valves of static operating voltages and conditions. *Metrix Instruments Limited, 54 Victoria Road, Surbiton, Surrey.*

PAVER

Flexible Operation

THE Parker Paver is a medium sized black top paver now in full production in this country.

The machine is based on an American design and has been used for laying tarmacadam base, topping on secondary roads and airfield strips. High claims are being made that the machine is particularly manouverable and has good accessibility.

The machine is built on a standard Fordson tractor and therefore benefits from the availability of spares and service. It can turn on an inside radius of 5 ft. There is hydraulic steering and the paving speeds range from 3 to 60 ft per minute making it easy to handle. The laying capacity is up to 80 tons per hour. For laying, the machine has four forward gears and one reverse; for travelling there are six forward and two reverse gears. Control of the laying speed and most other functions is hydraulic.

The screed is heated by bottled gas.

Precise crowning adjustment is fitted and the paving depth is from ½ in upwards. With a weight of 6½ tons it is said to have sufficient power to be able to push heavily loaded ten wheel trucks.

The pusher rollers and the feed hoppers at the front of the machine are adjustable for height to suit various types of truck. The material from the hopper is taken to the rear of the paver by a transfer conveyor. An oscillating cutter-compactor bar finally lays and compacts the material and a floating screed mounted at the rear compacts and dresses it still further. *Frederick Parker Limited, Viaduct Works, Catherine Street (Extension), Leicester.*

HYDRAULIC VALVE

Feel Control

A SPECIAL claim for a new hydraulic valve is that the operator can " feel " the pressure he is controlling.

The type 4879 valve is designed specifically for the hydraulic operation of heavy duty clutch and brake mechanisms of the types that are met with on cranes and winches or any similar mechanisms that require constant manual control. It has a maximum working pressure of 1,500 lb per sq. in and requires a force of 18 lb to move the lever to its maximum position. It is this force, which varies in proportion to the degree of movement, that gives the operator the sense of feel of control.

Another advantage claimed for this valve is that increased movement of the control gives a corresponding increase in hydraulic pressure thus providing progressive braking or declutching.

Three models are available, for pressures of 500, 1,200, and 1,500 lb per sq. in; port sizes are all ¾ in BSP. The valves can be supplied singly or in multiples of six. *Keelavite Hydraulics Limited, Allesley, Warwickshire.*

6th EUROPEAN MACHINE TOOL EXHIBITION

Paris 12 to 21 September

The space at the CNIT building was not so large as at Hanover in 1957 and many exhibitors felt themselves cramped. Still the range of machines was about as wide as possible and access was good. Impressive was the number of automatic and semi-automatic control systems, from the simplest sequence operation to the full three-dimensional tape control. We look forward now to the exhibition at Olympia next year to see how far this trend will have developed. Some of the exhibits at Paris were described in our issues of 4 and 25 September and more are detailed here.

ROUTER

High Speeds in Three Dimensions

THE type HYR three dimensional router has been designed to enable high speed routing techniques to be applied to work previously done on die-sinking and copying machines.

The router head carries a special back slide which incorporates a hydraulic cylinder. This cylinder is actuated by an overhead stylus that contacts a model secured on a carrier above the router head and imparts an inverse movement to the head. The stylus has a vertical adjustment of 3 in on any one setting. In addition the head slide also carries a hand operated adjustment of 12 in. The maximum depth of component that can be worked is 16 in and the maximum depth of contour 6 in.

The 12½ h.p. router head runs at 18,000 or 12,000 r.p.m. and is carried on a rigid arm having an effective radius of 73 in maximum and 33 in minimum. The arm moves on ball bearing rollers housed in a carriage mounted on a barrel located in the main frame. The barrel is mounted in preloaded taper roller bearings. The entire arm mounting is designed to ensure absolute accuracy on all movements.

A lock on the arm allows sweeps to be made with the arm set in any required position. A similar lock can also be provided on the barrel. The overhead template structure is supported on substantial vertical columns.

The work table may be either fixed or have a power operated rise and fall movement. The working surface is 84 in by 36 in. An alternative arrangement has a table surface of 152 in by 30 in with the router mounted on a bed and power traversed. *Wadkin Limited, Green Lane Works, Leicester.*

GEAR SHAVER

Hopper Feed and Automatic Cycle

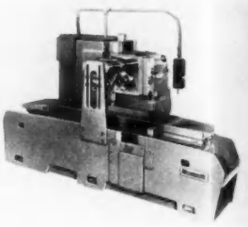
THE VS4A is a fine pitch gear shaving machine that has been fitted with a hopper feed and automatic cycle operation.

It was originally developed for the rapid shaving of fine pitch spur and helical gears. The principle of operation is that the shaving tool rotates in mesh with the gear to be shaved and the required cross-axis angle is set in the tool slide. The work is traversed across the shaving tool and the centre distance is progressively reduced in each of four longitudinal strokes until the finished size is obtained. There are four tool speeds and the stroke is adjustable up to 1 in in steps of $\frac{1}{16}$ in.

The machine will handle gears up to 4 in diameter maximum and down to ½ in minimum. The maximum gear face width is 1 in and the diametrical pitch 16. The four tool speeds range from 110 to 373 r.p.m. and the infeed has a maximum rate of 0·01 in. The main motor for the shaving tool is ½ h.p. while that for the feed and pump drive is ¼ h.p. A four-pass cycle is fitted as standard, but 2, 6, or 8 pass cycles can be supplied. Full electrical and pneumatic interlocking is included and on autocycle the machine is safeguarded against faulty or uncut blanks. *W. E. Sykes Limited, Manor Works, Staines, Middlesex.*

HORIZONTAL MILL

Dial-A-Cycle Programme Control



THE Mil-Waukee-Mil now being made in this country under licence is a bed type milling machine fitted with the Dial-a-Cycle programme control.

There are 84 standard models which include simplex and duplex designs and two types of spindle heads up to 30 h.p. Standard features include electrohydraulic control of all table movements, spindle and programming of automatic cycles, backlash eliminator, full pendant control, automatic quill retraction and power vertical feed. Tracer control and automatic quill clamping are also available.

All automatic cycles are programmed on the Dial-a-Cycle control panel. Each cycle is a sequence of machine functions, each of which is commanded by a multiselector phase switch. The trip post and dogs instruct the control when to initiate the succeeding functions as well as the table rates. The operator reads the sequence of functions directly from the workpiece drawing and merely dials each function on successive phase switches to constitute a complete automatic machining cycle. Cycles can be interrupted at any time without returning to the start position. Change from automatic to hand operation is by a switch.

The bed and column are of one piece construction and full length ways are integrally cast with the bed. Unit construction is a feature of spindle heads, feed drive units and feed gearbox. Double round overarms provide positive alignment of the arbor. *E. H. Jones (Machine Tools) Limited, Garantools House, Portland Road, Hove 3, Sussex.*

LATHE

General Purpose Heavy Duty Machine

THE Wohlenberg E57 lathe is a redesigned version of an older machine. In its new form it will take heavier work and has improved accuracy.

The speed range of the headstock has been retained giving a ratio of 1 to 200 in 24 steps through the faceplate rim gear as well as the final drive gear of the spindle. Twelve additional speeds through belts can be supplied to order thereby increasing the total range to 36 steps for a ratio of 1 to 280.

The speeds are engaged by means of two marked handwheels. Automatically operating locking devices prevent an engagement of the machine before the speed change has been completed. If an attempt to change speed is made while the machine is running, operation of the handwheels will cause an immediate standstill.

The main drive in the headstock has hardened and ground gears running on ground six-spline shafts. The spindle is mounted on three high precision bearings and the axial pressure is absorbed at the nose end to ensure freedom from compressive stress. The radial bearings take the form of adjustable double row cylindrical roller bearings.

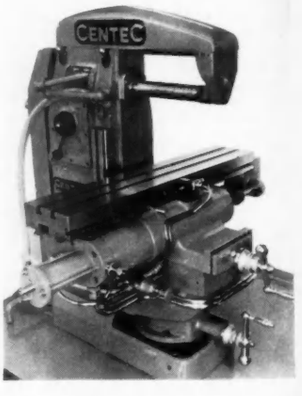
The quill of the tail stock has manual coarse and fine adjustment. A built-in spring compensating device absorbs axial expansion of the workpiece. The required axial pressure can be set in accordance with a table. It is indicated by a pressure gauge and can thus be controlled.

There are 18 sliding and surfacing feeds and 68 metric and Whitworth threads can be obtained either through the leadscrew or through the top slide with the carriage stationary.

A two or three shear bed can be supplied as required. Drive is from an a.c. slip ring motor of 84½ h.p. or a variable speed d.c. motor of 51 h.p. The motor stands on a pedestal base and the switchgear is housed in a separate cabinet. *Sykes Machine Tool Company Limited, Hythe Works, The Hythe, Staines, Middlesex.*

AUTOMATIC MILL

Hydropneumatic Table Drive



THE new model of the Centec 2B milling machine has been fitted with hydropneumatic operation for the table.

Chief claims for the drive are that it gives a very fast approach speed, about 1,200 in per min, coupled with a preset hydraulic infinitely variable feed. For automatic production the machine can be fitted with a sequence control system, the panel for which is mounted on the front of the main stand. On this panel are mounted limit switches that control all the movements of the table, including length of travel, distance of approach, cutting feed and fast return.

The table has a traverse of 12 in and measures 5 in by 25 in. As stated above, the approach speed is 1,200 in per min and the return is 420 in per min. The distance from table to spindle is 7$\frac{5}{16}$ in but this can be increased by inserting an additional block. The vertical traverse is 7$\frac{5}{16}$ in and the cross traverse 5$\frac{1}{8}$ in. The cutting feeds are steplessly variable up to 420 in per min. The spindle is driven by a 1 h.p. motor. The machine will work at very high production rates and can be fitted with a vertical milling attachment if desired. The firm's standard index tables can also be used. *Centec Machine Tools Limited, Centec Works, Hemel Hempstead, Hertfordshire.*

V-8 Engines Make a Powerful Comeback

Two of Britain's leading luxury car manufacturers have used V-8 engines in their latest models. They are compact and relatively economical and may mark a return of V-8's to high power production cars.

Luxury Rolls-Royce and Bentley

For the past five years Rolls-Royce have been developing a completely new aluminium V-8 engine which will now be used in their three latest cars; the Bentley S2, the Rolls-Royce Silver Cloud II and Phantom V.

This new high powered engine is an over square 90° unit of some 6,230 c.c., having a bore 104·4 mm and a stroke of 91·44 mm. The cylinder block and heads are cast in high silicon content aluminium alloy, cylinder liners are "wet" and valve seats are in austenitic steel. Cast iron is used for the inlet valve guides and bronze for the exhaust guides. The five main bearings of the crankshaft are copper-lead-indium lined steel shells.

Twin carburettors of special diaphragm design are used and incorporate automatic chokes for cold starting. Impregnated paper filtration is used in the air cleaner, which is attached to the bonnet top so that it lifts clear of the engine to give better accessibility. Three acoustically designed silencers in series are incorporated in the exhaust system, each one tuned to absorb a different range of frequencies.

In spite of its increased size and power, this eight-cylinder engine is said to be no heavier than its straight 6 (4,887 c.c.) predecessor due mainly to the use of aluminium alloy. Factors which help to achieve the traditional Rolls-Royce smoothness are the relatively low compression ratio of 8 : 1, static and dynamic balancing of the crankshaft and hydraulic tappets. The fully automatic transmission, which has been standard on all Rolls-Royce and Bentley cars for some years, remains unchanged.

After five years of development, Rolls-Royce have produced a 6¼ litre V-8 engine which will replace the present 5 litre in-line 6 with hardly any increase in overall weight. The compression ratio remains at 8·0 : 1.

Sporting Daimler

A Daimler with a difference, the new SP250 appears to have all the necessary ingredients of a top class sports car. Using only 2½ litres, in an eight cylinder V formation, the designer Mr. Edward Turner has achieved a compact power unit capable of some 140 b.h.p. at 5,800 r.p.m. The top speed of the car is over 120 m.p.h. and the standing quarter mile can be done in only 16·9 sec.

This entirely new engine has light alloy cylinder heads carrying overhead valves (in hemispherical combustion chambers) operated by short alloy pushrods from a central camshaft. Double high duty valve springs and an automatic timing chain adjuster are incorporated. Bore and stroke are 76·2 mm by 69·85 mm, giving a total displacement of 2,547 c.c. and a compression ratio of 8·2 : 1. Twin inclined SU carburettors are fed by an SU electric fuel pump.

Reinforced polyester resin is used for the body, which has an impressive aerodynamic shape, and contributes to a favourable power-to-weight ratio. The separate chassis has a box section structure with cruciform bracing carrying independent front suspension by the Girling system. However, the rear suspension looks somewhat limited in that the axle is mounted directly on half elliptical springs, with the chassis frame under the axle. This would appear to give limited travel for the rear suspension on such a low slung chassis.

The braking system is well in keeping with the high speed performance of the car. Disc brakes are used on all wheels with 10⅜ in diameter at the front and 10 in diameter at the rear. Steering is cam type with a 17 in diameter spring spoke wheel giving 2·6 turns from lock to lock. The turning circle is 33 ft 6 in.

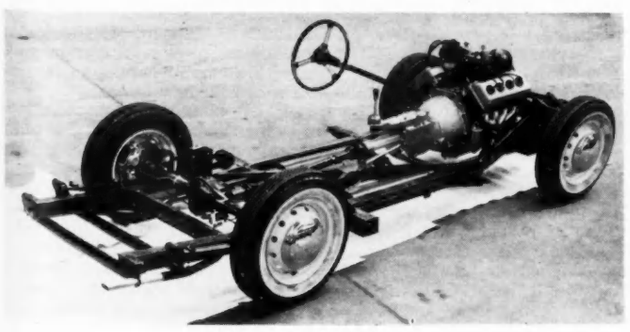
Automatic transmission by Borg Warner and Laycock de Normanville overdrive are both available as extras, otherwise a conventional four speed gearbox with direct drive top gear and synchromesh on the top three ratios is fitted. The final drive is through a hypoid bevel, semi-floating with a ratio of 3·58 : 1.

Production is expected to be about 100 per week in the first instance. Models for the home market should begin to appear early in 1960.

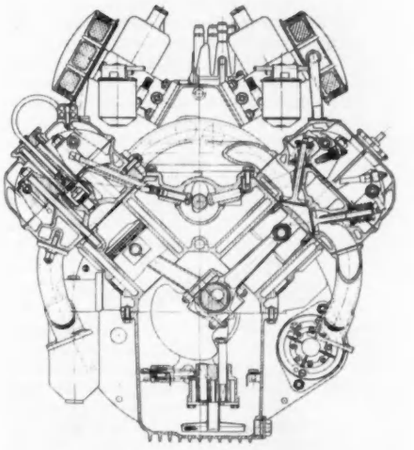
Aerodynamically designed, the Daimler SP250 is capable of a top speed of 120 m.p.h.

Manufacturers' Performance Data

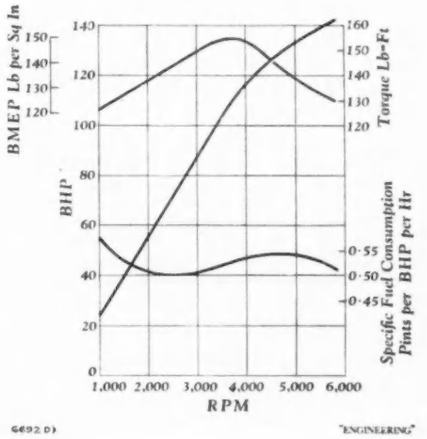
Acceleration through the gears:	
0-30 m.p.h.	3·4 sec
0-60 ,,	9·1 ,,
0-80 ,,	16·3 ,,
0-100 ,,	26·9 ,,
Standing ¼ mile	16·9 ,,
Acceleration in top gear:	
20-40 m.p.h.	7·2 sec
40-60 ,,	7·3 ,,
60-80 ,,	8·3 ,,
80-100 ,,	12·0 ,,
Petrol consumption:	
At constant 30 m.p.h.	38 m.p.g.
,, ,, 50 ,,	33·2 ,,
,, ,, 70 ,,	27·5 ,,
,, ,, 100 ,,	20·6 ,,
Maximum speeds (flying quarter mile):	
Top gear	120 m.p.h.
3rd gear	104 ,,
2nd gear	73 ,,



The separate chassis frame consists of box-section side members, with cruciform bracing, underslung at the rear. Front suspension is independent. Rear suspension uses half elliptics with piston dampers.



The engine has eight cylinders disposed in 90° V formation with a total capacity of 2½ litres. Maximum power is 140 b.h.p. at 5,800 r.p.m. Compression ratio is 8·2 : 1.



(Right) Engine performance curves.

Furnaces for Finland

The placing of a £9,000 order for an electric annealing furnace by Oy Vuoksenniska Ab of Finland with Birlec, of Birmingham, follows the supply of seven furnaces to the company, and will bring their total value to £60,000. Finland has so far expressed only interest in the Outer Seven free trade area talks, but Birlec report that the six European countries with whom the talks have been pursued have taken 20 per cent of their total exports in the last five years. The company's latest furnace for Oy Vuoksenniska Ab is of the lift-off bell type, designed for annealing steel bars in length up to 6 metres. This is the third furnace of this type order by OVA, who already have Birlec heat treatment and melting furnaces totalling 5,000 kVA.

The United Kingdom Atomic Energy Authority has ordered two special furnaces for annealing reactor fuel elements from Birlec at a total cost of £22,000. A high degree of vacuum (10^{-4} mercury) will be maintained in the heating chamber to protect the charge, which is uranium dioxide pellets in sealed beryllium tubes, against oxidation. Three Birlec continuous electric furnaces have also been installed in the production heat treatment plant at the recently opened Glasgow factory of the Caterpillar Tractor Company. One of these is designed for the cycle-annealing of forgings, carrying out on a predetermined time/temperature schedule in automatic succession, several stages in the heat treatment cycle previously carried out separately. One of the main advantages gained by subjecting every forging received to a standard annealing cycle is uniformity of machineability: the standardisation of feeds and speeds thus made possible in the machine shop helps to maintain the even flow of work vital to the efficient running of a modern production system. For the English Steel Company, Sheffield, Birlec is to build at a cost above £65,000 one of the largest electric heat treatment furnaces in this country. The furnace, of the pit type and having a rating of 1,220 kW, is to be used for the heat treatment of alloy steel forgings weighing up to 100 tons.

Iron Curtain Contracts

The part which Western European engineers can play in meeting the needs of iron curtain countries is illustrated by two recent contracts. In one, the Polish Government have entered into a licence agreement with Burmeister and Wain for the construction of B and W engines, and in the other, Russia has ordered mining equipment to the value of over £250,000 from F. Taylor and Sons (Manchester) Limited and Climax Rock Drill and Engineering Limited. Taylor and Sons (Manchester) are members of the Steel group of companies of Sunderland and Climax Rock Drill are members of the Holman group of Camborne, Cornwall.

The Russian order calls for four mobile, telescopic tower scaling carriages and 15 mobile drilling machines, each mounted with four Holman SL280 drifter drills. This equipment which, the Russians say, " will be used for drilling very hard rock faces," represents the very latest design in mobile mining plant and is the result of many years research and development. The machines are known as the Taylor-Hurd mobile electric mining drills, each weighing 15 tons and mounted on crawler tracks. Four hydraulically operated booms are attached to the drilling platform, each carrying a Holman SL280 drifter of 3½ in bore. The four booms may be raised or lowered, slewed and rotated either individually or simultaneously. All movements are operated from the elevated platform and it will be possible to drill rock faces up to 32 ft in height.

The B and W agreement followed keen interest in their engines in Poland. Already some 30 plants were on order and it seemed in the interest of both parties that these very large engines should be built locally as they are in other countries. The builders will be Stocznia Gdanska, which is the largest shipyard in Poland. More than 120 machine tools have been purchased to reequip the engine works. In the first instance only one of B and W's engines, a turbo charged two-stroke engine developing 5,000 b.h.p., will be built there, to B and W's constructional drawings.

Swiss Fortnight

Hard on the heels of the joint conference in London on expanding British exports to Sweden, with its special significance in the context of Outer Seven discussions, comes the Swiss Fortnight with the accent on trade, still within the Seven, but in the other direction.

From Monday, 5 October, until Saturday, 17 October, all the thousands who know Switzerland as a land of alps, kirsch, and exotic chocolate, will be able in London and the provinces to discover just exactly how well Swiss industry is keeping up in the technological race. The Swiss light engineering products and precision instruments exhibition will be at Hulton House in Fleet Street, London. Sulzer Brothers, Brown Boveri, Hasler, Oerlikon Engineering, Zurich-Oerlikon, and H. W. Egli are among 25 firms who will be showing products from typewriters to electronic impulse counters.

One of the heavy-weights is showing at the Swiss industrial architecture exhibition, organised by the Royal Institute of British Architects at their headquarters at 66 Portland Place, London, W1. This is Escher Wyss, of Zurich, who exhibit a special purpose high pressure rotor, which is a spare from a turbine installation at Reutlingen, Southern Germany. The Escher Wyss firm was founded in 1805, starting with textile machinery but by 1830 they were building steam engines and ships. Following the design in 1903 by the firm's technical manager, Dr. H. Zoelly, of a steam turbine which became as famous as those of Parsons and De Laval, the company rose to a world position in the production of both steam and water turbines. There are now works, and associates, in Italy, the United States, South Africa and Austria.

The 1958 trade figures between Britain and Switzerland were: British imports from Switzerland £36,238,926, Swiss imports from Britain £36,603,152.

Sixth Generation

Sulzer Brothers celebrate this year the 125th anniversary of their foundation. It was in 1834 that a deed was drawn up and attested by the notary public whereby the town council of Winterthur ceded to " Jacob Sulzer, founder and turner, father," a piece of meadowland on the road to Toss in return for his garden and small foundry outside one of the town gates, together with a sum of 600 gulden in cash. They became a public company in 1914 but the management still includes members of the fifth and sixth generation of the family founded by Salomon Sulzer nearly 200 years ago. They employ over 10,000 people in four works, at Winterthur, Oberwinterthur, Bulach and Soleure. At Oberwinterthur a new foundry completed last year covers 345,000 sq. ft.

The history of their growth is highly instructive for those who look back into industrial development to find the key to progress. Their range of proprietary products, which now comprises diesel engines, gas turbines, pumps, fans, steam boiler plants, high-pressure pipe lines, steam turbines, compressors and blowers, refrigerating machinery, heating and air conditioning installations, weaving machines and foundry products, was begun by the steam engine—of the horizontal poppet-valve type—which they exhibited at the 1867 World Fair in Paris.

In 1841 they constructed their first steam boiler and are now among the world's leading manufacturers. The Sulzer monotube steam generators are being erected for supercritical pressures up to 5,600 lb per sq. in, and outputs up to 325 MW per unit.

Overspill at Steel's

The industrial phase of the Glasgow Overspill Plan was officially inaugurated on Tuesday, 16 September, by the opening of the new premises of Archibald Low and Son in Kirkintilloch, 9 miles north of Glasgow. The plan aims at relieving the chronic congestion in the areas of Glasgow built during the uncontrolled expansion of the industrial revolution, where more than 80,000 people live with 3 persons to a room, and over 30,000 with 4 to a room, sharing toilet facilities and lacking baths.

Two phases of the plan are already under way; these are the building of modern blocks of flats in new development areas within the city, and the attraction of outside industries to designated reception areas outside the city in the hope that many employees will be drawn from Glasgow. These measures are inadequate as long as the bulk of employment continues to be provided in the redevelopment areas of Glasgow.

Archibald Low and Sons were established in Glasgow over a century ago as ships' pipe fitters and plumbers. In 1946 they became a member of the Steel Group of Companies. Their long history has been characterised by cycles of expansion and subsequent relocation, always within Glasgow, until the present move was necessitated. Kirkintilloch is a town of 15,000 people, and is expected to expand to a population of 23,000 under the overspill plan.

The new premises comprise a three-bay workshop and office block located on an eight acre site that leaves room for the addition of six bays. The first bay is devoted to the company's traditional business: pipe fabrication, primarily by bending rather than welding. Main products are heating coils for tankers and tank cars. In the centre bay aluminium gratings and walkways are fabricated. The third bay has been extensively reequipped with general purpose machinery for steel plate fabrication to a maximum plate size of ⅝ in by 8 ft or 1½ in by 10 ft, and a maximum assembly weight of seven and a half tons. It is hoped that the move, which represents an investment of £160,000 for the company, will result in a diversification of the company's activities, and a change from the present character of jobbing to considerable series or mass production.

Recent Acquisitions

The Universal Asbestos Manufacturing group of companies have acquired the entire share capital of Chancery Insulations Limited, specialists in the application of " Seel " sprayed asbestos for insulation, fire protection, and the prevention of condensation. Murex Welding Processes Limited have purchased Donald Ross and Partners, specialists in the design and manufacture of mechanical aids to production and in particular the well-known " Twinner " positioners for hand and automatic welding. English Steel Spring Corporation Limited, members of the English Steel group, have acquired the business of W. Griffiths and Sons Limited. In this case, however, it is the railway spring buiness and some items of plant which have been purchased. W. Griffith and Sons will cease trading.

Hawker Siddeley are rarely out of the news as business buyers. After their purchase of Folland Aircraft they have now acquired the rotating machine section of Veritys Limited, of Birmingham, and are transferring this business to the Loughborough works of Brush Electrical Engineering Company Limited. In future all machines manufactured in accordance with Verity designs will be marketed as the Brush-Verity range. Continuity of design as regards interchangeability and spares is being arranged.

The Truth about Youth

From the traditional apprentice owning only the clothes he stood up in and following his father's trade, to the car owning contemporary apprentice with money in the bank and perhaps even a wife, is a long step.

A fine focus on 400 of these well endowed industrial beginners is provided by the Industrial Welfare Society in a survey made at their annual apprentice conference, held recently at Oxford. The answers given by the 400 showed strong evidence of thrift. Half had life insurance policies, almost half Post Office savings accounts, a quarter trustee savings bank accounts.

Trade union doubts about wage payment by cheque may look forward to less support from the rank and file since more than a quarter of these youngsters already have bank accounts. The often heard complaint from trade union elders of the lack of interest shown by the young shows up in the figure of almost 60 per cent not belonging to a union although 80 per cent were members of organisations, among them youth and sports clubs and the Territorial Army. Surprisingly, 35 per cent said they not only went to church but attended regularly.

The home influence, or at least a possibility of it, remains strong since 90 per cent live at home, one third of them giving between £2 and £3 a week to their parents, a quarter between £3 and £4 and another quarter between £1 and £2. Only one in five of the fathers was a skilled industrial craftsman. They included ministers of religion and bookmakers as well as senior managers and labourers.

Those who see Britain as moving toward an entirely middle class nation can draw comfort from the apprentices' replies in which 60 per cent describe their families as middle or lower middle class, 15 per cent do not believe in class at all and only 25 per cent claim to come from the working class.

While almost a third have been abroad and 40 per cent say they would like to emigrate, there are 45 per cent determined young men who answered that definitely they would not emigrate. There is little sign of the American pattern of every young man having a chairman's dividend warrant in his lunch box. Only 10 per cent expect to reach executive rank and some 30 per cent expect to become supervisors.

The apprentice of the moon rocket age still has one link with his fellows of last century and beyond. Spelling was generally atrocious: in many cases "Don't know" going down as "Dont no."

Safety Contests Wrong?

A comprehensive guide to industrial safety has been published by the Stationery Office under the title *Accidents at Factories, Docks, Building Operations and Works of Engineering Construction.*" (HMSO 1*s* 3*d*). This 36-page booklet describing how accidents happen and how to prevent them, is based on the experience of actual notified accidents.

Another contribution to accident prevention is made by the National Institute of Industrial Psychology in a report on an "attitude survey" they have carried out among the 550 employees of a factory in the South of England. The NIIP investigators found that the workers were critical of some aspects of the safety rules and campaigns. They were sceptical about the Company's slogan that safety came before production, saying that if this were really true there would not be incentive bonus schemes which encouraged hasty and careless actions. The full-time safety officer was said not to have enough authority to deal with the needs and problems of particular departments. The workers disliked safety competitions in which employees' days off through injury counted against the record of a department or group. It was felt that this might constitute pressure on people to return to work before they were fit, and the practice of putting such workers on light duties was regarded as confirming this. Many of the workers thought that safety competitions were wrong in principle and were not fair to all the participants because people in different departments were exposed to different hazards. The investigators also found that safety notices and bulletins, and monthly manager's meetings on safety were making less impact than was desirable.

Fellows from Canada

One of the best methods yet devised for spreading engineering and scientific knowledge between the members of the Commonwealth and at the same time strengthening the bonds linking its people is the Athlone Fellowship Scheme. The latest group of Athlone Fellows, who are all young Canadians, mostly graduates direct from universities, recently arrived, forty strong, in Britain.

Begun in 1951 by the Board of Trade who provide the grants, the scheme has so far brought 340 Canadian engineers to this country. After an introduction to British industrial resources, trades unions, industrial relations and social structure, handled with wit and imagination by the British Council Overseas Students Centre, the Fellows move on to works training in companies, with consulting engineers, or post-graduate study in a university or research establishment, or to a combination of all three.

Each engineer's two year stay is meant to give him first hand knowledge of the British industry and of research and development here. The benefit to increased Canadian-United Kingdom understanding and to a broader basis of personal contacts in trade across the Atlantic is an obvious one.

Engineering Refreshers

A refresher course for senior works and plant engineers is to be held this winter at Leeds University. The course, which is organised by the pro-chancellor of the University, is the latest of a series of major courses at various centres in Britain, all of which have set up enrolment records for engineering refresher courses. The Leeds course will comprise 18 weekly lectures on Thursday evenings, commencing on 29 October.

The Institution of Plant Engineers announcing the course state that it is designed "to encourage the most effective use of existing knowledge and to promote the application of up-to-date techniques in works engineering practice over a broad field." The syllabus is extensive and each subject is treated by specialists drawn in the main from industry. The fee for the course is four guineas and copies of the syllabus and full particulars may be obtained from the Secretary to the Refresher Course, Department of Engineering, The University, Leeds 2 (Telephone: 31751).

Union Elections

Mr. Claude Berridge, last Communist on the Amalgamated Engineering Union national executive, retained his place with a straight majority over his two opponents. The figures were Mr. Berridge 6,664 votes; Mr. Tom Chapman, North London divisional organiser, 3,706, and Mr. H. V. Field 826. Mr. Chapman is about to become involved in the preliminaries for the election of his own post, which he is defending. Mr. Berridge is back on the executive for three years. Mr. Chapman's tenure runs out next July and he is expected to have to contend with Communist opposition.

In the Electrical Trades Union Mr. Frank Foulkes seems assured of re-election for a further five year term as president. He is reported to have been nominated by 400 branches, compared with 50 nominations for his opponent. A second ETU election, for the general secretaryship at present held by the Communist Mr. Frank Haxell, takes place later this year.

Too Few Engineers

There is still a great shortage of engineers and scientists in the civil service. This is emphasised in the annual report of the Civil Service Commissioners for the year April, 1958, to March, 1959 (HMSO 2*s* 6*d*). "We have again been faced," state the Commissioners, "with a shortage of good candidates for scientific officer, engineering and draughtsmen posts, and many vacancies remain unfilled." There is a dearth of physicists and also of mechanical and electrical engineers, civil engineers, architects and quantity surveyors which is worrying the Commissioners.

The report is a most interesting commentary on the changing conditions of recruitment, and on the lost appeal of the civil service to outstanding young men and women in most trades and professions. Recruitment methods are being adjusted to take advantage of new factors, such as the growing popularity of recruitment of school leavers through competitions based on the General Certificate of Education. Several measures have been taken to improve recruitment to the executive and clerical classes and to the grade of clerical assistant, where the proportion of unfilled vacancies is greatest.

Overall, there appears to be a lack of appeal which cannot be explained entirely by the lower salary scales as compared with industry or by ineffective recruitment methods. A more likely explanation is that industry is quicker to fasten on the young people it really wants and willing to go further initially to keep them.

Two Angles on Job Study

The considerable progress made by trade unions in the United States in the field of industrial engineering is the subject of a special article in the September issue of *UPA Monthly Report*, the journal of the United Patternmakers' Association. The article points out that American unions use staff trained in the techniques of industrial engineering and that some actually propose plant reorganisations, product changes or new production methods to protect their members' interests. There is a general recognition that union members have everything to gain from greater efficiency. It is emphasised that such activities must be "controlled and regulated by the collective bargaining process."

The role of the union industrial engineer is described in the words of Mr. Solomon Barkin, director of research for the forceful Textile Workers Union of America: "The union employs the industrial engineer on its own staff not to provide it with a time study with which to counter those made by the management (unless the management's time-study man is not truly competent).

"His primary purpose is to define the irregularities on the job overlooked by the management's time-study man—the complexities and dimensions which have been missed; the judgments and assumptions which should be questioned; the work which has been neglected; the attention and personal factors which must be given more credit; the allowances which should be added—and to analyse the data collected by the management's staff. His responsibility is to define the alternatives which the union may consider in formulating its counter proposals as to earnings and levels of work application.

"His function is to provide the materials for negotiations which include an evaluation of the import of each factor of the job and the worker's expectations and judgments."

Technical Digests Simplify Understanding

Research organisations must have results circulated quickly and widely. At Napiers, digests are a single side of foolscap, or less. Colours correlate conditions and distinguish sections of the text. The layout is essentially diagrammatic.

By F. Machon, Technical Information Engineer

Research Laboratories, D. Napier and Son Ltd.

The communication problem of a research organisation which has a wide range of interests and a large number of possible clients can be simply stated; it is to see that its work is known to everyone at all likely to be concerned. In this it can hardly expect to be wholly successful. To the extent to which it fails, the information produced is wasted, because some who would have been interested do not come to know of it, while the support the research receives is less than it justifies, and the scale of the effort may be restricted. One cannot, of course, know the interests of everyone in a large circle of correspondents, and a special effort must be made by the research organisation to keep closely in touch.

Full Research Reports, however, are not suitable for maintaining the channels of communication between the research organisation and its clients and potential clients, and any form of publication intended to keep open channels of communication with engineers having a wide range of interests and points of view must assume only a very modest effort and interest by its readers, at least initially. It must be easily assimilated and as interesting as possible in its own right. Obviously some kind of digest is required.

THE DIAGRAMMATIC DIGEST

As the Napier Research Laboratories developed from serving the one company, in the days when it specialised entirely in engines, to working on the wider problems of the English Electric Group and other heavy industrial organisations, these considerations became sufficiently important to justify special attention.

In addition to other changes in the reporting system, which enable very rapid reports to be made where necessary, it was decided to publish digests of all reports not restricted by considerations of commercial security and not of obviously small general interest. The basic form of these digests was developed before the scheme started by means of exercises within the Napier Research Laboratories. In this organisation the presentation of information has been given proper attention for some time, and from their considerable experience the members of the Laboratories were able to make suggestions which were invaluable. This careful approach also ensured that the new publication would receive positive assistance from the authors of reports.

The series was begun to a loose specification which might be summarised as follows.

Each digest to fill one side only of a foolscap sheet.

The layout to be attractive, and to include diagrams freely.

The greatest accuracy to be required, and the agreement of authors to be secured before publication.

Above all, they must to be true digests, original pieces of work to quite new terms of reference, explaining the investigation described in the report in their own way.

TECHNIQUE

The digests are printed on a spirit duplicator which enables a number of colours to be used without the possibility of errors of registration. About 300 usable copies are taken on paper already printed at the head and foot, and of these perhaps 50 are of the highest quality. The result does not look expensive, but efforts are made to avoid its looking cheap and nasty, and it does reflect the austere attitude of the laboratory in its spending of other peoples' money.

It has been found that this method can be used, with care and experience, to produce colour drawings of quite presentable quality even of such difficult subjects as the damage to failed roller bearings.

The digest reproduced here does not describe one of Napier's more significant pieces of work, for various reasons that can easily be imagined. It was selected principally as depending comparatively little upon the use of colour, but even so it appears less attractive and less logically arranged by being uncoloured.

The colour is used purposefully, although welcome for its decorative effect. It has two main purposes:

(1) To represent different conditions, tests or so forth. The colour code is established quite clearly first, and then curves, text and parts of diagrams are done in the colour that indicates the condition to which they refer. This saves the space that would be required for identifying text, and the effort of reading it.

(2) The text is arranged not so much in paragraphs as in independent blocks, and colour may be used to distinguish these. This enables more text to be included without an appearance of crowding and also assists selective reading of the digest. The introduction and conclusion, for instance, are often done in the same heavy colour, and details of the test conditions in a different lighter one.

We try to design the digest to fill, and make a pleasing composition within, the framework of the one foolscap side. We do not employ a professional illustrator and there is not always time to persevere with the design until we are entirely satisfied, but this is what we attempt. The free use of drawings tends to make the arrangement attractive and the breaking up of the text into separate blocks seems to promise from each a definite piece of information without excessive concentration. When a digest is good it looks unstrained and relaxing. On this account abbreviation of words and telegram-like writing is not normally used.

Less obviously, digests are made attractive by being evidently purposeful and well organised, so that the reader whose interest has been caught at his first glance may continue, feeling that he is getting somewhere rapidly without leaving too many loose ends. As far as possible, digests do not merely list the points made in the reports; they make them in their own way. However, if a man is going to find that the investigation concerns conditions in which he has no interest, the sooner he does so the better, so the precise scope of the work is defined as early as possible.

To guide the reading of the digest and to contribute towards the effect of purpose, the text may be set out so that its organisation is plain from its superficial appearance. In particular, this is helpful when items are being listed, grouped or compared. Thus the sentence; " During the tests the oil pressure, outer race temperature and torque were noted," could be set out in the form:

During the tests the oil pressure, outer race temperature and torque were noted.

In a digest of this type, however, it would probably be changed a little, and would appear as:

During the tests, we noted;
the oil pressure,
the outer race temperature,
the torque.

This warns the reader well in advance that he is about to consider a list of items in some way similar. The example is elementary, but it illustrates the point that the shape of the text, before ever one begins to read it, can be of great assistance in making the plan of the exposition plain.

The best contribution to attractiveness, clarity and the rest, however, is to use diagrams wherever possible. The diagram is the fundamental language of the engineer to which he instinctively turns when he explains himself. The reader notes the part of a diagram in which he is interested and rejects the rest almost uncon-

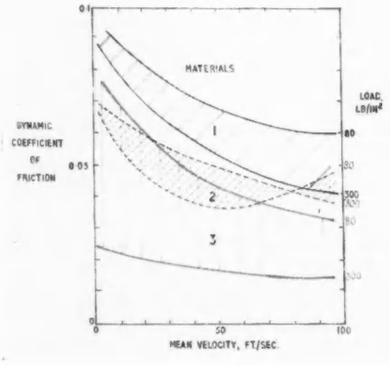


Fig. 1 (left) Envelope diagrams can be used to advantage in digests. In the original the three materials were distinguished by colours.

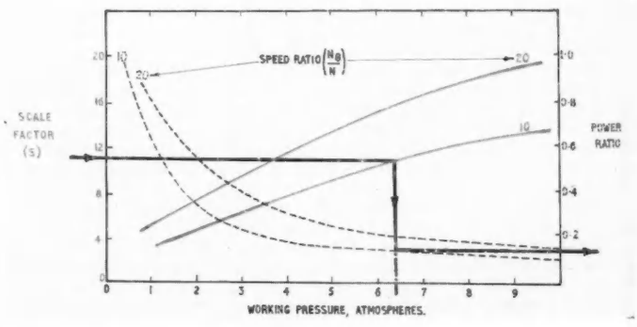


Fig. 2 (right) Curves showing methods of use are also given in colour. These and the diagram on the opposite page are exact reproductions.

sciously, so that a diagram appeals to a wider range of technical levels and interests than does a written account. From the diagram of the test apparatus in the example digest, one reader might receive from a rapid inspection the impression that a stoutly constructed sensing device, probably having a comparatively fragile element, suitable for insertion through the walls of a pressurised vessel, and capable of having the element removed without the removal of the whole device, is connected through an electronic system so as to produce a permanent record on film. Another, with different interests, might retain the information that a varying resistance in the sensing head is connected in a conventional a.c. bridge system to a double trace oscilloscope, the second trace providing a time reference of variable frequency. A third reader might care to note merely that the equipment is inexpensive and robust. If the description is written, on the other hand, every reader must read the whole, deliberately rejecting what is not required, and unless the description is very detailed many readers may be left with unanswered questions.

Immediate visualisation of a mechanical device is greatly assisted if drawings are made three-dimensional as far as possible. Great liberties can be taken with both convention and reality in digest diagrams, without the reader being troubled, or even noticing it, and all sorts of drawing problems may be solved simply by this means. In the example digest, for instance, part of each tube is made transparent and the cathode ray oscilloscope is represented only by its face, but the reader not concerned with the mechanics of the presentation would probably not consciously observe this at all.

A similar completeness, accuracy and brevity is often obtained by using graphical illustrations. Several of the common methods of manipulating curves are used to reduce graphical information to a single diagram or to show more complex relationships. The two most useful of these are perhaps the envelope type of curve, shown in Fig. 1, and the diagram which shows the method of use, Fig. 2.

Fig. 1 is reproduced from the digest of a report which gave the characteristics of certain friction materials. The curves for each of three materials are included in a single diagram and identified by colour. The group of curves for each material is represented by an envelope which extends between the two extremes of test load, given earlier in the digest concerned. Again, a written description explaining all the significant information in this diagram would be quite lengthy, and very painful reading.

Fig. 2 need not be explained in detail. As it appeared in the digest the two sets of curves and their respective vertical coordinates were in identifying colours and the arrowed line showing the method of use was in a third colour. Clearly, the power ratio is determined by taking the working pressure corresponding to the scale factor at the required speed ratio and then obtaining the power ratio from the working pressure/power ratio curve for that same speed ratio. But how much more easily the diagram says it.

Digests must be accurate; a very small rate of error would lose them all serious attention. They must also be seen within the laboratory to be accurate, and must not usurp the responsibility for accuracy which belongs to the authors of the reports. Napier digests are therefore discussed informally at the draft stage with the authors of the report, and agreement is reached. The authors participate fully in the design, and it is a tribute to them that amicable agreement is always reached without any necessity to define fields of responsibility in detail.

A real effort of concentration is necessary to comprehend a report so as to be able to make a digest of this sort, and this is a searching test of the report itself. Statements which had been accepted when separated in the report by pages of detail may appear incompatible when brought together on a single sheet. Omissions may become apparent. Conclusions drawn from graphical evidence are seen even more starkly when they appear on the digest as short annotations to the curves themselves. The method of discussing report and digest together, before publication, enables the report to be edited with little additional effort, and perhaps with less controversy than if there were no digest.

In making a digest, particularly, it is profitable to challenge all conventions, clichés and accepted forms. This has been mentioned as regards diagrams. In the text of digests there is a particular objection to those superfluous adjectives, and those lengthy tortured phrases which are apparently designed to guard against even a deliberate attempt to attribute a slightly different meaning to that intended. Where so few words are used they must not be wasted. There is no point in describing the bearing as " pre-greased," for instance, when " greased " is quite sufficient.

One must take care, however. I have just read, ". . . a small but determined amount of air was admitted."

Fig. 3 An example of a Napier digest. The original is on a sheet of foolscap and is in several colours.

NAPIER RESEARCH REPORT DIGEST

No. 2304.D April 1958

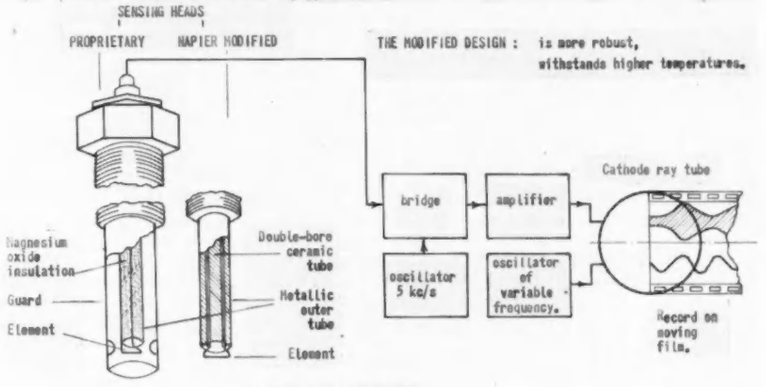
FINE-WIRE RESISTANCE THERMOMETERS FOR HIGH TRANSIENT TEMPERATURES

A proprietary instrument has been tested in a shock tube under controlled conditions of rapid and wide temperature variation, and in the exhaust system of a diesel engine.

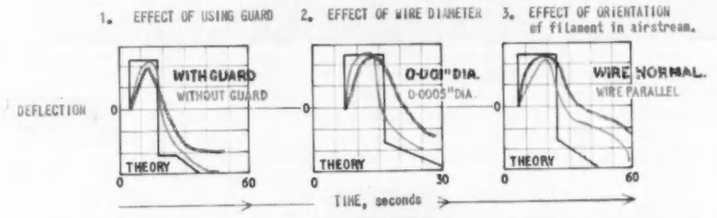
Tests have also been made with a modified design.

The theory of the shock tube and of the heat transfer to fine-wire thermometers is given in brief. Proposals for the development of the apparatus are made, including automatic allowance for the time lag.

THE INSTRUMENTS



PERFORMANCE DATA



PERFORMANCE LIMITATIONS OF THE THERMOMETER WITH THE NAPIER-DEVELOPED SENSING HEAD

Response frequency : to square-wave excitation, with 0.0005 in. diameter wire filament, 65 c/s.

Temperature : tested to between minus 100°C and plus 500°C, but higher temperatures would be possible.

Engine conditions : an unexplained increase in basic resistance was observed, possibly due to coking.

PROPOSALS FOR FURTHER DEVELOPMENT

Proposals are made for :

1. developing the sensing head for temperatures up to about 1000° C.,
2. investigating the increase in basic resistance noted in the engine tests,
3. designing an electronic device for appreciating and correcting for the time-constant of the instrument while it is operating.

A detailed mathematical treatment for 3 is given.

THE RESEARCH LABORATORIES, D. NAPIER & SON, LTD., LONDON, W.3.
Phone: SHEpherds Bush 1220. Extension 163. Internal No. 309

GETTING TO GRIPS WITH ANALYSIS

One of those rare occasions when different specialists talked specialities, and yet found a common interest, was provided by a symposium on the use of computers in structural engineering held recently at the University of Southampton. The symposium was organised by the department of civil engineering in conjunction with the departments of aeronautical engineering and computation. There was no doubt that the engineers were keenly interested in what the applied mathematicians had to say and both the civil and aeronautical engineers had thought deeply about the mathematical basis of their studies and had made contributions to applied mathematics.

It seems clear that we have turned a corner in our thought on basic structural theory, and discarded the multitude of methods for special problem solution in favour of general analyses derived from fundamentals of force and displacement relationships. It would seem that this was by good fortune rather than as a result of the advent of the electronic computer. Nevertheless, it is also quite clear that the computer would have forced this change and it has certainly speeded up the process.

The formal proceedings of the symposium were conducted in nine sessions. The first was devoted to a paper by Dr. C. M. Wilson entitled "The History and Development of Electronic Digital Computers." Dr. Wilson referred principally to British machines and described their evolution. He then discussed the trend in the next generation of computers, and how this would affect the scientific user—principally the storage sizes, speed and logical basis of complete computing systems.

In the second paper, "The Solution of Partial Differential Equations by Relaxation on an Electronic Computer," Professor D. N. de G. Allen described the methods he has been using to carry out relaxation computations. The first part of the problem is the degree of generality required in the programme. While a quite general programme is possible Professor Allen has preferred to specialise in those he has used, and on this occasion he concerned himself mainly with the harmonic equation. He discussed the various devices he had used to improve a simple stage-by-stage iteration scanning the field. The most valuable proceedure appeared to be a controlled over-relaxation.

Following Professor Allen, Dr. D. Brotton read his paper entitled "The Economic Use of Electronic Digital Computers," in which he explained his use of physical matrix partitioning by the method of subframes when frame problems became large. In the fourth session, Mr. J. C. de C. Henderson, Mr. A. D. Edwards and Mr. J. Munroe read a paper on their programming of the force method of linear analysis using influence coefficients. A general programme was described which used matrix machine coding.

Mr. H. Tottenham's paper, "Linear Analysis of Spacial Structures," described a new analysis of multiple shells and plates which may best be described as a generalised Macauley method. It was shown that, by continued matrix transformation, many otherwise complex computations can be set up straightforwardly for machine calculation, and that the order of the problem is much reduced.

Up to this stage of the proceedings the papers had exclusively concerned the digital machine, but the sixth session was devoted to a paper, "The Use of Analogue Computers for Structural Problems," by Dr. J. P. Jones. Dr. Jones described the special attributes of such machines, in particular, their value in exploratory calculations where parameters are required to be changed during the calculation, and for non-linear and coupled sets of equations.

Dr. Jones was followed by Dr. R. K. Livesley with a paper entitled "The Application of Computers to Problems Involving Plasticity." Dr. Livesley described the way in which he had reorganised an elastic analysis programme to introduce plastic hinges successively as the elastic moments in members are exceeded when the load factor is increased in finite steps. He also mentioned the troubles he had encountered in solving large sets of simultaneous equations by a method of successive operations of orthogonalisation of solutions. This lack of success had lead him to investigate more deeply methods of solving the sort of equation which arises in structural frame calculations.

In the last paper, "Matrix Analysis of Fuselages and the Digital Computer," Professor J. H. Argyris reviewed the highly organised methods of computer analysis which he and his colleagues have developed for highly complex aircraft structures. These derive directly from the fundamental force or displacement method and depend for their success upon the techniques of selecting the unknowns and of dealing with non-uniformities. Professor Argyris reported successful analysis of fuselage problems involving 400 to 500 redundants and intimated that structures with 1,000 redundants could be tackled.

The final session differed from the rest in being a discussion without paper, and by being concerned with design rather than with analysis. The chair was taken by Professor P. B. Morice and many members of the symposium took part, lead by Mr. D. G. Owen.

The symposium was a residential one, thus enabling informal proceedings to become as important as the formal ones. It also made possible the allocation of time for demonstrations on both digital and analogue machines. The Ferranti Pegasus and Sirius digital computers were shown as well as Donner analogue computers. The meeting was filled to its limit of 120 people and attracted a number of visitors from abroad.

ELECTRICAL AND MECHANICAL SERVICES FOR A HOSPITAL

The engineering services of a modern hospital are as complex as may be found in any other form of building. To illustrate the point, the following is a brief statement of the electrical and mechanical installations planned for the Welwyn-Hatfield general hospital for which the foundation stone was laid last month.

Heating, hot water and steam will be supplied from a central boiler of the economic shell type, oil fired. Integral with the boiler house will be the calorifier plant supplying the main hospital with central heating and all hot water. Heating will be by pipes embedded in the structure of floors and ceilings, recessed flush-faced radiant panels, recessed convectors, conventional radiators and gilled tubing housed under low window sills. All of these will be thermostatically controlled according to local conditions. In addition, those rooms that are used only intermittently will be zoned so that the heating will be in operation only when required.

The hot water supply will be fed from storage calorifiers through piping independent of the central heating. The supply will also serve towel rails, and blanket and bedpan cupboards. A separate calorifier will supply hot water to the bedpan washers to avoid the risk of cross-infection through contamination of the main water services. Reduced pressure circuits will feed autoclaves, sterilisers, cooking apparatus and some radiant panels for summer heating.

All water will be obtained from the local water company, and there will be direct connections to the company's mains for the drinking supply. Cold water for sinks, lavatories, showers and cisterns will come directly from a bulk storage but all hot water will be served from a bulk softened water supply. A hydrotherapy pool will take water through a separate filtration and heating plant that will change all the water every four hours.

The principal ventilation plant is to be housed on the roof of the clinical block and additional separate equipment will deal with special rooms such as the kitchens, lavatories and postmortem rooms. Two separate plants will each serve two operating theatres in the main theatre suite; provision is being made so that refrigeration equipment can be installed if it is required. Oxygen will be piped from a central store to all operating theatres, recovery rooms and selected beds in each ward.

Two central suction plants will also be installed, one on the lower ground floor to deal with matter from the pharmacy, pathological laboratories and postmortem room; the second, located on the roof, will deal solely with the operating theatre suite.

All food and crockery will be issued from the kitchen in heated food trolleys, the dirty crockery being returned to a central mechanical washer adjacent to the main kitchen. The equipment in the kitchen will be steam or gas heated, and there will also be refrigerated stores for food.

The electrical services will be obtained from a nearby substation of the Eastern Electricity Board. At the substation the incoming high voltage will be transformed down to 415 volts for power and to 240 volts for lighting and general purpose work. In addition, a diesel alternator standby set in the central boiler compound will supply the hospital automatically in the event of a current failure. The distribution has been so designed that any fault in one section will not shut down the whole hospital but limit the blackout to the particular section.

Lighting throughout the hospital will be a blend of fluorescent and incandescent, according to location. Generally the fittings will be mounted direct on to the ceiling, semi-recessed or completely flush with the surface, to avoid the accumulation of dust. The hospital roads will be illuminated by fluorescent standards which will be automatically switched on and off.

Ample general purpose power points will be installed in all laboratories, and for cleaning and miscellaneous uses. Each bed will have its own point for iron lung work and other medical equipment; this point will be fitted in the bed-heat unit. A patient-to-nurse call system will ensure that all calls remain registered until cancelled by the nurse at the bedside. This call system will also be fitted in the bedhed along with a two-programme radio system and the bed-light switches.

In the operating theatres shadowless lamps will be installed and an emergency battery set will automatically come into use in the event of a mains failure. Special panels will also be fitted for a variety of electrical circuits, including viewing screens for X-ray plates. In addition to the main X-ray suite, provision is also being made for all major portable X-ray equipment to be usable throughout all the ward areas.

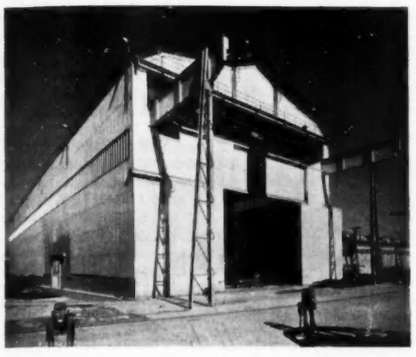
There are to be seven lifts in the main hospital block. Four of these will be completely automatic in operation, including power operated doors. These lifts will be able to take patients in bed and any associated medical equipment to any floor without transfer to stretchers. All other lifts (apart from the service lifts) will be able to take stretchers and medical equipment.

Fire alarms, clocks and telephones will be installed in accordance with modern practice,

NEW SHOPS IN TWO SHIPYARDS

Prefabrication is the key to modern shipbuilding. No longer is every ship's plate positioned and fixed separately; large sections, frequently weighing as much as 15 or 20 tons and comprising framing and plates, are now put together in the shops and erected as complete units. To meet this change in technique many shipyards have had to put up new prefabrication shops. Two such buildings are to be found at the Neptune Works of Swan, Hunter and Wigham Richardson Limited, of Newcastle, and at the Kingston Works of Lithgows Limited, of Port Glasgow. In both cases the new structures are clad in aluminium.

At the Neptune Works the new assembly shed is a steel-framed building 400 ft long, 90 ft wide and 70 ft high. The overhead travelling gantry cranes are carried on girders that project beyond



The new prefabrication shop for Swan, Hunter and Wigham Richardson.

the building at both ends, enabling completed assemblies to be moved into the open through sliding doors. The cladding of the buildings, including the roof and the main sliding doors, is entirely unpainted aluminium, the walling being of Noral standard industrial corrugated sheets supplied by Northern Aluminium and fixed by Freeman Morrison Limited, industrial roofing engineers of Newcastle. The same sheeting has also been used for new platers' shops and subassembly buildings, which have 70,000 sq. ft of floor area, which stand nearby.

An even larger prefabrication shop has been built at the Port Glasgow works of Lithgows; it is 466 ft long, 100 ft wide and is 67 ft high. Unpainted Noral sheet, 29 tons in all, has been used throughout for the cladding. It was fixed by Baileys (Bristol) Limited for the Fairfield Shipbuilding and Engineering Company, who are erecting buildings for the owners.

In both cases the choice of aluminium sheeting was determined in part by the relatively small amount of maintenance that will be required despite an atmosphere where corrosive sea air is strengthened by both smoke and industrial. Added advantages claimed by the makers are the lightness of the sheet and that the troughed profile chosen permits the wide spacing of the purlins—up to 7 ft 6 in or even 9 ft for 20 s.w.g. (0·036 in) sheeting.

Concluding **Hospital Services**

including provision for a patients' bedside telephone service. Members of the hospital staff will be contacted anywhere in the hospital by means of a personal call location system using miniature pocket receivers that pick up only those signals intended for the carrier. In the outpatients departments, a consultants signalling system has been designed that will allow patients to be " filtered " with the minimum of delay into small waiting rooms associated with a particular consulting room.

Dry Goods and Cold Store Built in Record Time

In 10 weeks a disused railway station and yard at King's Lynn have been cleared and a single-storey storage depot with a floor area of 30,000 sq. ft has been built. The depot includes a cold store of a 100,000 cu. ft capacity. A rail connection runs into the building.

In that 10 weeks the area has been cleared, the building designed and erected (after sinking about 500 Frankipiles), and the cold store almost completed. The depot has been built for Harry Pointer (Norwich) Limited for whom the consulting engineers have been Frederick Snow and Partners. Poor ground—ash filling and silt above soft clay down to 45 ft—dictated close piling. Coseley Buildings of Wolverhampton supplied the main steel-framed and asbestos-sheeted structure; the frame is built up of standard Coseley portal frames of 60 ft span. The floor has been built at wagon-floor height to minimise handling of goods and consists of an Omnia concrete floor built above a gridwork of reinforced concrete beams.

The refrigeration and insulation contractor has been Mann Egerton of Norwich. Expanded polystyrene has been used to line the cold stores in which a temperature of − 10° F can be maintained. The possibility of differential settlement below the cold store has been countered by the close piling and ground-beam structure.

Commenting on the speed of the work, a member of the consulting engineer's staff acknowledged the owner's part in laying down the requirements and sticking to them and the cooperation given by the contractors.

Coloured Aluminium and Glass in Power Station Buildings

Willington A power station, opened on 2 October, in the East Midlands division of the CEGB, has four 100 MW turbo-alternators. The four boilers (830,000 lb per hour evaporation) are arranged " four square " with two turbo-alternators flanking the north and south sides of the square; the fuel bunkers and dust collecting plant are situated along the east-west axis.

Each pair of turbo-alternators is enclosed in a reinforced concrete framed hall with a lightweight concrete barrel-vault roof and Alochromed aluminium sheeting and glass cladding above brick plinth walls. The buildings around the boilers and other plant are steel framed but similarly clad; aluminium and glass boxes cover the tops of the boilers. All the ancillary buildings (except the coal handling towers) have exposed reinforced concrete frames, brick plinths and aluminium and glass claddings.

The Basilica of St. Pius X, Lourdes

A paper describing the new basilica of St. Pius X at Lourdes is to be given at the Institution of Civil Engineers on 8 October at 6 p.m. The author is M. J. Chaudesaigues, director of Entreprises Campenon Bernard. The meeting is sponsored jointly by the British Section of the Société des Ingéneurs Civils de France and the Cement and Concrete Association.

1,000 ft Television Mast Erected in 10 Weeks

The highest man-made structure in the United Kingdom is the new television mast erected at Mendlesham, Suffolk. It is 1,000 ft high and weights 140 tons. The design and erection were the work of the British Insulated Callender's Construction Company; the steelwork was fabricated and galvanised by Painter Brothers of Hereford.

The mast is three sided, each side being 8 ft 6 in wide; the corner posts are solid steel rounds which are braced by an angle steel lattice; the gussets are welded to the posts but the bracing is rivetted. Steel wire stays support the mast which is mounted above a 2 in diameter steel ball. Erection was completed in 10 weeks.

Chiswick Flyover Opened to Traffic

The Chiswick flyover connecting the Cromwell Road Extension and the Great West Road has been brought into use. It is the first major two-level highway scheme to be carried out in the Greater London area since the war.

By the scheme a through road for London's new western approach is provided above a 400 ft diameter roundabout that distributes the traffic to other roads meeting at the junction. Slip roads provide links from the roundabout to the high-level through road. About 40,000 vehicles a day use the junction.

The flyover scheme has been built to the requirements of the Ministry of Transport and Civil Aviation for whom the consulting engineers have been Harry Brompton and Partners, of Hobart Place, London, SW1. It is hoped to give further details of the new work in a subsequent issue.

Modern Factory Construction for Instrument Manufacturers

The new plant for Texas Instruments Limited in Bedford will have a series of hyperbolic paraboloid shells for the roof designed originally by Candella. Construction difficulties will be eased by casting the floors of the upper storeys and the roof of the office block at ground level and then raising them on jacks to their final position. The contract has been awarded to Tarmac Civil Engineering, Limited, London.

The consultants for the project are Oscar Faber and Partners and an $\frac{1}{8}$ scale model of one of the shells has been tested at Wexham Springs to determine deflections under eccentric loading and generalised stress conditions. This roof form was chosen so as to take advantage of glazing to the full height of the building so that a high standard of lighting for the operatives is so obtained. Air conditioning is to be installed throughout the whole production area.

Gatwick Airport Extensions

Tenders are going to be let for a telecommunications establishment at Gatwick Airport. The value of the contract will be around £250,000. When complete the establishment will be used by the Ministry of Transport and Civil Aviation to conduct experiments to improve telecommunications at airports.

The new laboratories and offices are to be in a single-storey building designed by Frederick S. Snow and Partners, who were consultants for the airport. A full description of Gatwick was given in ENGINEERING, p. 652, 23 May, 1958.

CEGB Contracts For Power Stations

During the past two months the Central Electricity Generating Board have placed contracts for power stations, transmission lines and transformer stations together worth £8 million. Included among these contracts are the following:—

Padiham B: railway sidings, Thos. W. Ward Limited.

Thorpe Marsh: foundations for main buildings, Holloway Brothers (London) Limited.

Trawsfynydd: reconstruction of dam and other reservoir works, Sir Alfred McAlpine and Son, Limited.

Uskmouth B: cooling water outfall works, Holloway Brothers; civil works for circulating water ducts and coal ash and dust handling plant, M. J. Gleeson (Contractors) Limited; reinforced concrete chimney, Mitchell Construction Company Limited.

World Programme

So much has happened in the field of atomic energy since the first installment of World Programme appeared in Atomic Review on 29 August, 1958, that this week's addition might almost belong to a different century. Although Notes and News reports weekly the significant nuclear events, the purpose of World Programme is to place these events into an international perspective: to point out gaps and opportunities and the level of competition in other countries. The series will be continued and expanded as material, some from the Export Services Branch of the Board of Trade, becomes available. (World Programme appeared in Atomic Review on 29 August, 1958, 2, 9, 16, 23 January and 4 September, 1959.)

Switzerland

Most of Switzerland's electricity comes from hydro-electric sources and she is a net exporter of power. Eventually nuclear power will be required, but there is no agreement on how soon or how much. One estimate by a member of the Special Atomic Energy Committee, M. Petitpierre, put the likely nuclear requirement in 1977 at 6,000 million kWh.

Resources

Uranium-bearing ore deposits have been discovered in Canton Valais but they have not been investigated sufficiently to judge their commercial value.

Organisation

Early in 1956 a Special Atomic Energy Committee was set up by the Federal Council. It comprises the head of the political department, head of the department of public economy, and the head of the Federal Railways. A company called Reactor AG was formed in 1955 and has as shareholders about 150 Swiss industrial firms, the Government contributing up to 11·8 million Swiss francs to the running expenses. The principal aim of Reactor AG is research.

Research

Reactor AG has two research reactors at Würenlingen, Canton Aargau. SAPHIR is a swimming pool type with a power of 1 MW; it was bought from the United States Government. The other reactor is a 10 MW heavy-water cooled and moderated reactor and is being built to enable the Swiss to gain first hand experience in the construction of power plants using uranium and to train specialist personnel. It will also be used for materials testing isotope production, and as a test facility for ancillary equipment. A feature of the reactor is the provision of a number of experimental channels operating at a temperature considerably above the mean reactor temperature. The Swiss Parliament have allocated 160 million Swiss francs for nuclear research over five years to provide universities with research equipment and subsidise research students.

Plans

A boiling water reactor is to be constructed at Lausanne by Energie Nucleaire SA. It is to burn enriched uranium and generate 20 MW thermal, serving as a pilot scheme for future power stations and also as a training centre for technical staff. A generating capacity of 5 MW electrical is to be expected. Sulzer Brothers AG have drawn up plans for a heavy-water moderated reactor using natural uranium fuel, to provide heat and electricity, at the Ecole Polytechnique Fédérale, Zürich. The thermal output is likely to be 25 MW and the electrical, 5 MW. Suisatom AG are designing an experimental power station of about 15 MW capacity.

Companies and Consortia

Atomkraft AG was founded by Brown Boveri and Company Limited to design, construct, and operate nuclear power stations; at present it is mainly occupied with research. Suisatom is a consortium of the four main Swiss electricity undertakings; and Energie Nucleaire is a consortium of a number of firms in French-speaking Switzerland. Atomelektra AG was founded by Elektrowatt AG to construct a nuclear power station of about 30 MW capacity.

International Agreements

Agreements for cooperation on the peaceful uses of atomic energy have been concluded with the United States, Canada and France. In these agreements the Swiss attach particular importance to the exchange of students and specialists. Switzerland is also a member of the International Atomic Energy Agency. CERN is located at Meyrin, a suburb of Geneva.

Thailand

The 140 MW Yanhee hydroelectric project, supplemented by thermal power using indigenous lignite, will supply Thailand's power requirements in the immediate future. To promote industrialisation in the north-east, an area lacking conventional sources of power, a nuclear station in the 20 to 40 MW range is being considered.

Resources

An aerial survey of mineral resources is under way. Limited supplies of monazite are indicated.

Reactors

A one megawatt swimming-pool research reactor is scheduled for completion in 1961-62 at the Chulalongkorn University.

Uruguay

Uruguay makes great use of its hydroelectric resources but these cannot supply the whole of the electrical demand and the deficit is made up by thermal plants. Power supply in Uruguay is provided by the General Administration of Electrical Works and Telephones (UTE), who have set up a commission within their organisation, responsible for research and investigation of problems related to nuclear energy. The lack of known deposits of fossil fuels was an important stimulus for this move.

Research

The National Commission for Atomic Energy is examining the possibility of installing a research reactor, through an agreement with the United States. In this connection, consideration is also being given to the establishment of a research centre, to develop the teaching and technical application of nuclear energy as well as to carry out research. Although no decision has been taken on the type of reactor required, it seems likely that a swimming-pool type will be chosen, probably of 100 to 500 kW.

Venezuela

One of the main problems in Venezuela is to find users, in addition to the national steelworks, for the power generated by the Caroni hydroelectric project, which will have a capacity of 300 MW when completed. Thus a nuclear power reactor is not likely to be required in the foreseeable future. An experimental swimming-pool reactor is being constructed at the Institute of Scientific Research, near Caracas. This is the result of arrangements concluded by the previous government with the United States under the Atoms for Peace programme; although the project is being completed by the present Government, it seems unlikely that it will be extended in the near future.

Notes and News

Swiss Heavy Water Reactor

The Sulzer project referred to in World Programme, comprises a heavy-water reactor of 25 MW thermal power, which may be utilised either for the production of electricity or in combination with the existing district heating system associated with the Swiss Ecole Polytechnique Fédéral and situated in the town of Zürich. In view of this location the safety measures which have been proposed are in many respects more extreme than in existing plants, and the reactor will be situated in an underground cavern. The core, shown in Fig. 1, is heavy water moderated and cooled and utilises predominantly natural uranium as fuel. It is designed on the pressure-tube principle, in which coolant and moderator are separated by a pressure carrying wall. The heavy water coolant is pressurised to about 60 atmospheres (882 lb per sq. in) entering the reactor core at about 190° C (374° F) and leaving for the steam generators at a temperature of about 220° C (428° F). The moderator is kept under nominally atmospheric pressure and at a temperature of approximately 56° C (133° F) by circulation using a separate coolant system. The low grade heat removed from the moderator, about 8 per cent of the total heat production, is not utilised in any way. The moderator is contained in a cylindrical aluminium tank, surrounded at the sides and below by a graphite reflector. A total of 18 tons of heavy water will be required, of which 13 tons are in the moderator system.

Partial enrichment has been chosen for this small reactor, which is essentially a prototype, merely in order to reduce the capital cost. Larger models would use natural uranium fuel.

(P. de Haller and A. F. Fritzsche. *Sulzer Project for a Prototype Heavy Water Power Reactor for Location in an Underground Cavern.* P246 Switzerland.)

Financing Ispra

Under an agreement the Italian Government will provide up to $9 million for the construction of necessary buildings and a European school similar to that already established at Luxembourg. It will also make available at reasonable rents accommodation for the staff and families working at the centre. The Euratom Commission will contribute about $24 million to provide the equipment and facilities (and possibly buildings) required by the centre, together with approximately $15 million to cover the estimated operating costs of the centre up to the end of 1962. It is expected that by the end of this period a total of 1,200 research workers and assistants will be at work at Ispra.

Work at Ispra

The Ispra Centre, which is to be gradually transferred to Euratom, is to concentrate on research and development work in various fields of nuclear science and technology. In the transition period, its new test reactor will be used to carry out a programme drawn up by a joint Italian-Euratom board: priority will be given to the current programme of the CNRN (Comitato Nazionale per le Ricerche Nucleari), which will be undertaken in close collaboration with Italian research teams. This programme is mainly concerned with neutron and solid state physics and reactor calculations and metallurgy. In addition, work initiated by Euratom will be undertaken. This will include power reactor technology, research on instruments for use in reactors and in the nuclear industry generally, the chemistry of raw and worked materials, especially that concerned with highly radioactive products, specialist training and documentation.

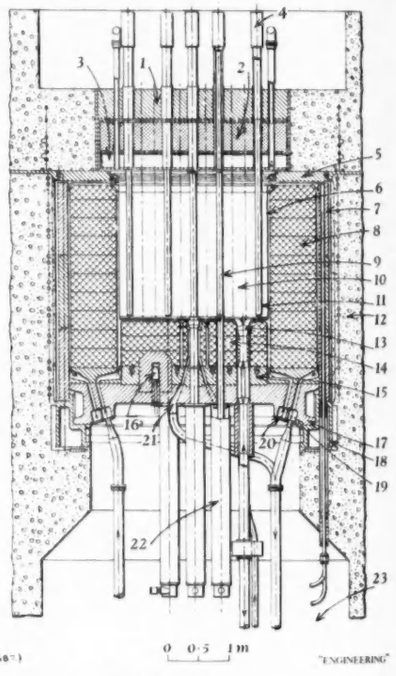


Fig. 1 Section of the Sulzer heavy-water moderated and cooled pressure-tube heating reactor.

1 steel cover plate
2 steel shield structure
3 water shield
4 fuel element mounting
5 supporting ring
6 moderator tank
7 radial thermal shield
8 radial reflector
9 control rod
10 moderator
11 fuel element
12 biological shield
13 moderator inlet
14 lower reflector
15 lower shield plate
16 neutron counter
17 baseplate
18 foundation ring
19 reflector coolant outlet
20 reflector coolant inlet
21 reflector coolant outlet
22 control rod drive
23 expansion space

Nuclear Safeguards Convention

The OEEC Convention on the Establishment of a Security Control in the Field of Nuclear Energy, which is designed to ensure, in particular, that joint nuclear facilities developed with the help of the organisation are used exclusively for peaceful purposes, has entered into force. The convention was signed by all OEEC member countries on 20 December, 1957. The ten countries which have now ratified it, so bringing it into force, are (in order of notification): the United Kingdom, Ireland, Switzerland, Norway, France, Denmark, the Netherlands, Turkey, Germany and Belgium. The operation of the control system specified in the convention will be the responsibility of the OEEC European Nuclear Energy Agency. This control is based on inspection of plant and the maintenance of accounts of all fissile materials used or produced, and ENEA's first task will be the preparation of control regulations and the setting up of an international control bureau, including the appointment of an international inspection team. The control convention provides for certain sanctions to be applied for failure to comply with its requirements, subject to the right of the government or undertaking concerned to appeal to a special international tribunal.

Portuguese Consortium

It is reported that a Portuguese nuclear engineering group has been formed to undertake construction of nuclear power stations. Companhia Portuguesa de Industrias Nucleares (CPIN) includes three marine organisations, a bank and 22 companies in the Chemical, metallurgical and electrical fields.

French Group

The Groupement Intersyndical de l'Industrie Nucleaire has been formed by French companies engaged in nuclear work to coordinate their interests in dealings with the French Government.

Swiss Consortium

A number of Swiss firms have set up a working group, the Konsortium für den Bau eines Versuchs-atomkraftwerks, to prepare projects for atomic power stations. They are Brown, Boveri; Contraves; Escher Wyss; Landis and Gyr; Oerlikon; Sulzer; and Zublin.

Czech Power Reactor

The 150 MW water reactor being built in the USSR for Czechozlavakia's first nuclear power station is said to have been completed.

Italian Power Reactors

It is reported that two more nuclear power plants, one in Piedmont and the other in Lombardy, are due to be built before 1965 by the Societa Meridionale par l'Energia Atomica, associates of AGIP Nucleare.

Pressurised Water Power Reactor for Italy

Società Elettronucleare Italiana (SELNI) of Milan, Italy, has signed a definitive contract with Westinghouse Electric International Company for the supply of a nuclear steam generating plant to be installed in the Italian company's Enrico Fermi atomic power project to be located in the northern part of the country. A provisional agreement between the two companies was signed previously. Gibbs and Hill, New York, are the consulting engineers on the project.

Scheduled to begin operation in spring of 1963, the project will have a net electrical capacity of about 160 MW. The reactor will be of the pressurised water type similar to that being built for the Yankee Atomic Electric Company.

Pressure Tube Reactor for Spain?

A new concept in nuclear reactor design is being studied jointly by a Spanish governmental agency and Westinghouse Electric Corporation as a basis for possible construction of an atomic electric generating station in Spain. The contract calls for studies of a pressure-tube water reactor for a proposed 20 MW power plant, similar to that being developed for Carolinas—Virginia Nuclear Power Associates at Parr Shoals, South Carolina.

Holland with Norway

Holland and Norway are reported to have signed a new agreement for cooperation in nuclear work, providing for exchanges of information and the joint administration of inventions. It is understood that a reactor centre is being built at Petten in Holland.

Neratoom

It is reported that a consortium has been formed in Holland to undertake construction of nuclear installations. To be registered as a limited company and known as Neratoom, the group comprises Philips, Machinefabriek Brada, Rotterdamsche Droogdok Mij, De Schelde, Stork, and Werkspoor.

Directors for Reactor Centrum

Dr. W. R. Reyseger and Ir. J. J. van Rijsinge have been appointed managing directors of Reactor Centrum Nederland.

Swedish Boiling Reactor

The Atomkraft Konsortiet (AKK) are reported to be seeking permission from the Swedish Government to build a 50 to 60 MW boiling-water reactor in the province of Smaaland, South Sweden.

Swedish Nuclear Glossary

The Swedish Centre for Technical Nomenclature is compiling a glossary of nuclear science terms in Swedish and English.

Swedish Uranium Refining Plant Hold Up

AB Atomenergi planned to have by 1963 a works at Billingen for refining uranium at the rate of 120 tons a year (AR, 28 June '57). Work has been stopped for want of sufficient Government finance.

Swedish-Canadian Cooperation

Both Sweden and Canada are concentrating their nuclear attention on natural-uranium heavy-water systems and the Swedish State Power Board has recently signed an agreement with the Hydroelectric Power Commission of Ontario for cooperation in the atomic-energy field.

Canadian Agreements

Apart from agreements with Britain, the United States, India and Sweden, Canada has recently undertaken to cooperate with Euratom, Australia and Japan in the exchange of technical information facilities, equipment and nuclear materials.

German Atomic Forum

A German Atomic Forum, with temporary headquarters in Dusseldorf, has been formed by a number of West German organisations. Professor Karl Winnacker, director of the I.G. Farben chemical works at Hoechst, has been elected president.

South African Atomic Energy Bill

A fund to finance a long-term research programme is called for by an atomic energy amendment bill being considered by the South African parliament. An expenditure of £800,000 annually over 5 years has already been promised.

Italian Nuclear Study Centre

It is reported that a nuclear study centre is to be constructed about 6 km from Pisa. Sponsored by the University of Pisa, the centre is to have a swimming pool reactor built by the university in conjunction with the Italian Naval Academy at Leghorn, probably with the American AMF concern serving as consultants.

Tenders Invited for Swedish Reactor

The Swedish State Power Board (*Vattenfallsstyrelsen*) has invited tenders from foreign suppliers for the 150 MW reactor for R4-Eva. The reactor will cost some Kr. 100 million. A foreign tender will only be considered if the cost is radically lower than required by ASEA and NOHAB.

Allis-Chalmers Acquire ACF Reactor Office

Allis-Chalmers Great Britain Limited have announced the purchase of the Commercial Nuclear Reactor Engineering Office, Washington, DC, of Nuclear Products—Erco Division of ACF Industries Incorporated in New York City, by Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, their parent company in the United States. Allis-Chalmers will take over ACF's commercial reactor organisation together with its contractual obligations for the design and construction of power, test and research reactors. At present they include the power reactor of Elk River, Minnesota, and test and research reactors at Wright-Patterson Air Force Base, as well as in Sweden and in the Netherlands.

GEC—Simon-Carves and APC Collaborate

Following discussions which have taken place during the last few weeks between the General Electric Co. Ltd. Simon-Carves Ltd. Atomic Energy Group and Atomic Power Constructions Ltd., an agreement has been reached to collaborate in the design and construction of nuclear power stations in the United Kingdom. The two groups have agreed to submit joint tenders for Dungeness and further stations in the British nuclear programme. This development doe not affect the two groups' existing contracts and commitments, either in the United Kingdom or Overseas. Negotiations are continuing with a view to long-term collaboration on future reactor systems.

Lockheed's Nuclear Associates

To achieve the optimum experience in nuclear power plant design and operation, Lockheed has joined forces with the Stearns-Roger Manufacturing Company of Denver, Colorado, and the American Hydrotherm Company of New York. Both have had extensive nuclear experience with installations at Oak Ridge (Tennessee), Hanford (Washington), and Sandia (New Mexico). Both will work as subcontractors to Lockheed's Nuclear Products Branch. Lockheed have recently received the first USAEC basic research contract awarded to industry.

Federation of Industries Study Nuclear Questions

It has recently been reported that the Federation of Industries of the Six (Union des Industries de la Communauté Européenne—UNICE) has set up a special committee for nuclear questions. The committee will be responsible for studying special questions relating to the application of the Euratom treaty so that common positions can be taken up by the interested industries of the six countries. (Export Services Branch, Board of Trade).

ANS and AIF Joint Activities

The American Nuclear Society and the Atomic Industrial Forum have announced plans to conduct a series of coordinated meetings. These two organisations are the largest in the United States devoted exclusively to the field of nuclear energy and radiation. These meetings are planned to bring into focus the latest development in both the technical and business phases of the peaceful uses of the atom. Independent sessions covering these two different aspects of the nuclear field are planned. A partial overlapping of the meeting schedules of the two key organisations should be a constructive step towards the avoidance of duplicate travel. The cooperative endeavours of the ANS and the AIF will thus bring together the scientists, engineers, and management personnel of the atomic industry through a series of conferences and expositions. Present planning includes coordinated meetings in the fall of 1959 in Washington, 1960 in San Francisco and in 1961 in New York City. Both organisations would continue to hold additional individual meetings throughout the year.

American Share of Small Reactor Market

Tenders have been invited by the United States Atomic Energy Commission for the design and construction of a 16·5 MW (e) pressurised-water power station under the Commission's Power Demonstration Programme. Those tendering will be expected to bear the cost of the plant site, buildings and non-nuclear components, as well as to undertake plant operation and to train operating personnel. During an initial ten-year period the Commission would sell the reactor produced steam to the operators, after which the reactor would be offered for sale. By installing a conventional superheater, the operator has the option of increasing the plant output to 22 MW (e). Construction of the plant is to begin in May, 1960, to be finished in two years.

Origin of Species

The brontosaurus died because it could not adapt itself to a changing environment. The climate of the power reactor business has undergone important changes; it calls for adaption. Some do it by genetic mutation, the birth of radical new ideas; others, like GEC—Simon-Carves, by evolution. Hunterston, the Galbraith proposal, and now the reactor described below: 530 MW (t)—150 MW (t)—55 MW (t); a reduction by a factor of ten accomplished without changing the fundamental engineering of the concept or stretching the limits of experience. The Generating Boards' brontosaurus shows remarkable powers of survival.

Process of Reiteration

Comparing sectional views of the two marine reactors—the Galbraith proposal in Atomic Review of 15 May, 1959, and Fig. 3 in this issue—shows their close relationship. Important advances have been made in the use of the shield structure, which now forms part of the containment vessel, the gamma shield and the water neutron-shield container. The graphite core retains the hexagonal shape but the restraint has been redesigned. The graphite structure is fully supported on two flats of the hexagon in a V-groove, the remaining flats receive a restraining load from hydraulic mechanisms which overcome acceleration forces. This arrangement permits the core to adjust to Wigner volume changes. The coolant circuits are identical, arranged to keep the entire pressure vessel at the temperature of the inlet gas. The circulator is a single-stage centrifugal impeller driven by a steam turbine outside the containment vessel to allow maintenance. Two shaft seals are used in series to prevent escape of active gas. The logistics of coolant make-up is solved by providing a shipboard plant for manufacturing high-purity carbon dioxide from bunker-oil combustion products.

Operating Versatility

On-load fuelling, a feature of the gas-cooled design, opens up the possibility of adapting the fuel cycle to suit the operating conditions. Once-through, batch loading, equilibrium fuelling, channel inversion or radial shuffling are possible, and each results in a slight reduction in the required enrichment at the expense of some operating inconvenience. For an average burnup of 12,000 MWD per tonne—a conservative value for stainless-steel clad uranium-oxide fuel—the period between refuelling would be over 100 days at full power, while the time required to reload one-third of the fuel in a three-batch cycle would take just over one day.

Power Transients

One of the principal hazards of highly-rated gas-cooled reactors is fuel-element melting following failure of gas circulation. The sign of the moderator temperature coefficient is important in this connection, and a reduction in the positive value under irradiated conditions—a consequence of enrichment—helps to improve the inherent safety of the reactor. Fig. 2, shows some analogue-computer studies of transients following ramp and step changes in coolant circulation rate. The conditions shown do not result in a temperature excursion sufficient to reach the melting point of the stainless steel can (1,450° C).

Alternative Power Rating

The reactor may be produced in two capacities giving 50,000 or 20,000 s.h.p. with substantially the same physical dimensions. Table I shows particulars of the smaller version, which, when compared with the Galbraith proposal, suffers from the inverse economy of scale with a specific weight of 36 tons per MW (t) versus only 16 for the larger plant. Table II shows a cost comparison for a 50,000 s.h.p. hypothetical oil tanker operating between the United Kingdom and the Persian Gulf via the Cape. The ship is assumed to complete five round trips per year with a total cargo of 500,000 tons, including fuel where applicable.

TABLE I

Parameters of the 20,000-s.h.p. Marine Installation		
Number of reactors	1	
Reactor heat output	55 MW	
Fuel and Canning		
Fuel	uranium dioxide	
enrichment	3 per cent	
total weight of uranium dioxide	1·39 tons	1·41 tonnes
Can material	18/8 stainless steel	
thickness	0·010 in	0·25 mm
maximum design surface temperature, including hot spots	1,370° F	743° C
Number of fuel elements	162	
Temperature coefficient of reactivity at operating temperature:		
fuel	$-2{\cdot}4 \times 10^{-5}$/° C	
moderator	$+4{\cdot}9 \times 10^{-5}$/° C	
Moderator and Reflector		
Material	Graphite, Grade A	
Nominal core diameter	7 ft	2,130 mm
Core length	7 ft	2,130 mm
Reflector thickness	2 ft	609 mm
Machined weight of graphite	44 tons	45 tonnes
Channel diameter	5·06 in	129 mm
Channel pitch, triangular	11 in	279 mm
Pressure Vessel		
Shape	cylindrical with dished ends	
Diameter, outside	15 ft 7 in	4,750 mm
Thickness	3½ in	89 mm
Working pressure, differential	385 lb/in²	27·1 kg/cm²
Maximum temperature	500° F	260° C
Control and Shut-Down Rods		
Number of control rods (cylindrical, boron steel, clad)	7	
Reactivity invested	19 per cent	
Number of shut-down rods	7	
Shielding Materials	2 per cent boron steel, steel, water, Hydrobord	
Coolant Circuit		
Gas	CO_2	
Maximum working pressure	400 lb/in², abs.	28·1 kg/cm²
Total maximum flow	371 lb/s	168 kg/s
Reactor inlet temperature	500° F	260° C
Reactor outlet temperature	1,020° F	549° C
Circuit pressure drop	50 lb/in²	3·5 kg/cm²
Steam-Raising Units		
Number	2	
Maximum evaporation (each s.r.u.)	80 555 lb/h	36 540 kg/h
Temperature at superheater outlet	850° F	454° C
Pressure at superheater outlet (gauge)	600 lb/in²	42·2 kg/cm²
Feed temperature	240° F	116° C
Pressure shell, inside diameter	7 ft 6 in	2,286 mm
thickness	13 in	44 mm
length, including domed head	34 ft 0⅛ in	10 382 mm
Summary of Weights	tons	tonnes
Pressure vessel	135	137
Pressure-vessel contents, including stand pipes, control rods, reactor, fuel, restraints, etc.	171	174
Primary circuit and CO_2 ancillary equipment	30	30
Steam-raising units (total) and ancillaries	115	117
Turbines and circulators	14	14
Charge-discharge machine and structure	80	81
Biological shield and header tank	1,234	1,254
Containment and Hydrobord shielding	161	164
Spent-fuel storage coffin	40	40
Total	1,980	2,012

TABLE II.—*Cost Analysis of 50,000 s.h.p. Tanker*

	Conventional	Nuclear
Total capital cost including propulsion unit	£5,000,000	£6,750,000
Annual cost of amortisation, maintenance and insurance	550,000	742,000
Annual fuel cost (375 × 10⁶ s.h.p.h.)	390,600	312,500
Other operating costs	75,000	100,000
Total annual cost	£1,015,600	£1,155,000
Tons of crude oil delivered	420,000	500,000
Cost per ton delivered	£2·42	£2·31

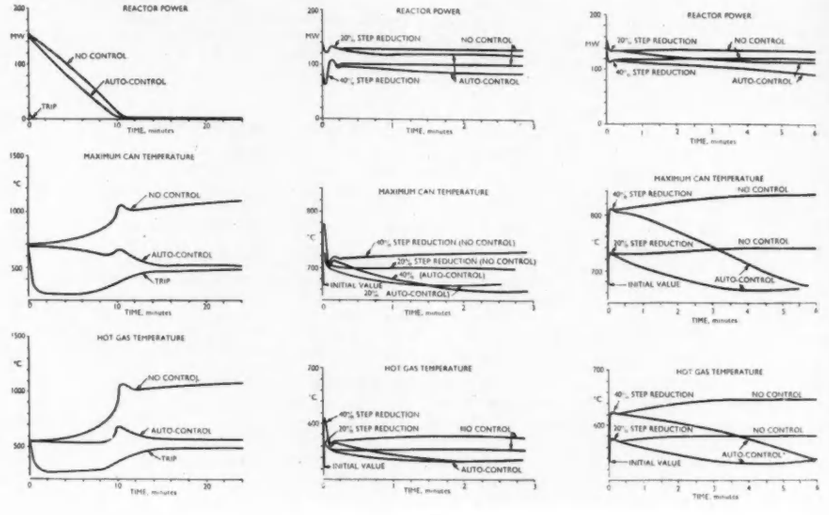
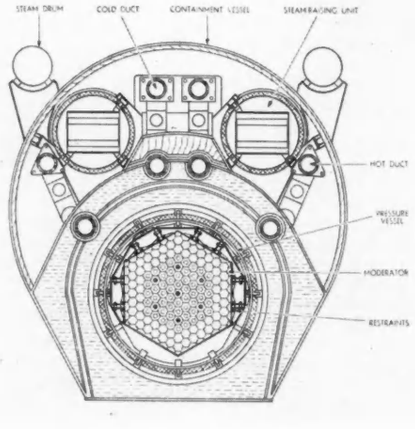


Fig. 2 (above) Transients following ramp and step coolant flow changes. Reactivity coefficient based on fuel surface temperature (left and centre) and on mean fuel temperature (right).



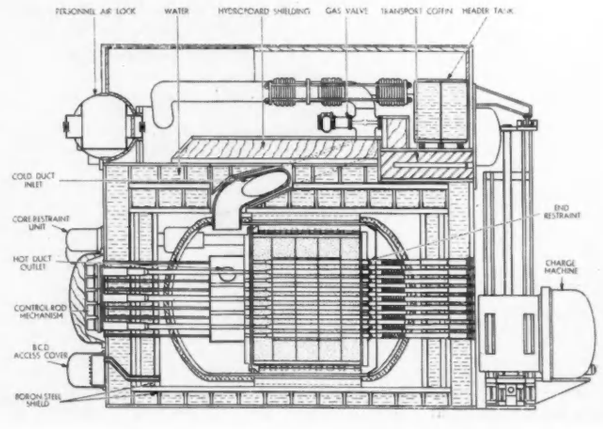


Fig. 3 (left) GEC—Simon-Carves gas-cooled graphite-moderated propulsion plant.

Journal Bearings with Gas Lubrication

Experimental work carried out on self-acting, pivoted-pad, gas-lubricated bearings is described. The problems of film stiffness and resonance are discussed and techniques given for deriving theoretical expresssions.

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The use of a gas to lubricate the bearing system of certain types of high-speed machinery has been described in a paper by G. W. K. Ford and others, published in 1957.[1] The problem of providing radial location for a rotating shaft in these applications has been solved in most cases by the use of a plain type gas journal bearing; but there are occasions when the problem is not readily solved in this way because of the possibility of the occurrence of " half-speed whirl " (the term used in gas lubrication to correspond with " oil film whirl " in oil lubrication). The pivoted-pad journal bearing, however, is free from half-speed whirl, as has been shown by A. C. Hagg,[2] and, therefore, is a useful alternative to the orthodox journal bearing in such cases. Another attractive feature of pad bearings is that they are able to cope with considerable shaft misalignment, which enables greater tolerances to be allowed in manufacture.

The absence of boundary lubrication and the low viscosity of a gas necessitate a somewhat different approach to gas bearing performance than is traditional with oil lubrication. Thus, the prime consideration in operating a gas bearing, is to preserve a gap between the moving and stationary parts, as contact between the two at speed is usually disastrous. Power loss, friction and temperature rise, so vital in oil lubrication, are of secondary importance because of the much lower viscosities involved. For instance, air has only one-thousandth the viscosity of a typical motor oil, SAE 30, at 75° C.

The idea of film stiffness (load per unit deflection) is also most important in gas bearings, as it has a much smaller value generally than for oil bearings. Thus, there is a danger of resonances occurring between the shaft mass and the springy gas film; such resonances being excited by slight residual out-of-balance in the shaft. Even the pads themselves may resonate individually on the gas film. Whatever the origin, a resonance is invariably disastrous and must be avoided at all costs.

The final parameter of importance in gas bearings is the take-off speed. This is the speed on start-up at which rubbing contact terminates and a gas film becomes fully established. It is desirable to have the take-off speed as low as possible, so as to minimise injury to the bearing surfaces on starting up.

The objects of the present article are to describe some experimental work carried out on self-acting air-lubricated pivoted-pad journal bearings, and to show how theoretical expressions can be deduced for the various types of film stiffness that are of practical interest. Formulae are also established for the corresponding resonant frequencies.

Apparatus and Experimental Method.—The experiments were carried out with the use of rig No. 1, which is shown in Fig. 1. The minimum gas film thickness in a 120° pad bearing, having a width of 5 in and a nominal diameter of 2 in, was measured for various conditions of load, speed and pivot position. The technique used was to measure the electrical capacity between the shaft and a small insulated probe mounted in the pad and lapped flush with the surface. The results, shown in Fig. 2, indicated that, when the pivot position was 60° or 80° from the leading edge, the well-known law for a plane slider lubricated with an incompressible fluid was obeyed:

$$\frac{\text{load} \times (\text{minimum gap})^2}{\text{speed}} = \text{constant}$$

For the pivot position 40° from the leading edge (i.e., forward of the centre point) the law was modified to the form:

$$\frac{\text{load} \times (\text{minimum gap})^{2\cdot 2}}{\text{speed}} = \text{constant}$$

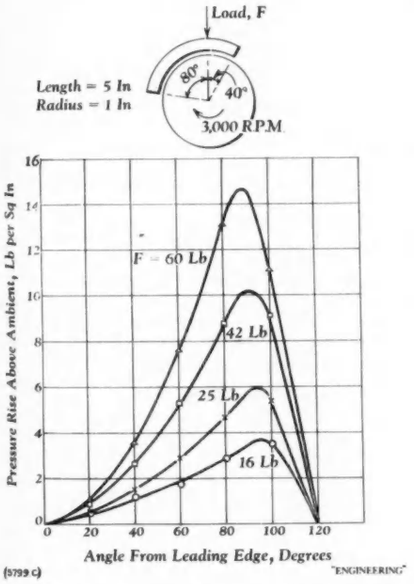

Fig. 3 Variations of pressure in the direction of motion for four different loads, the speed being constant.

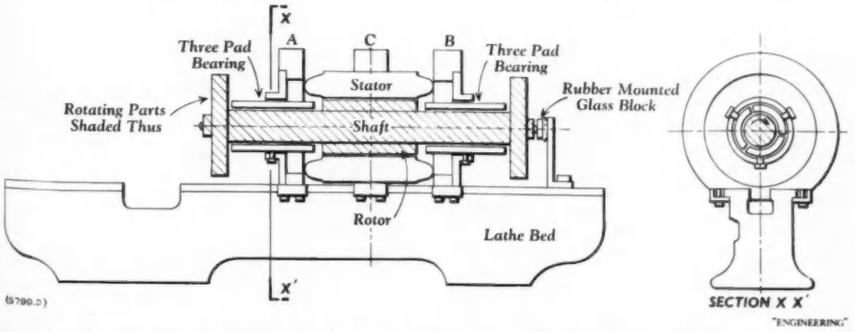

Fig. 4 Rig No. 2 used in the successful operation of a full-scale bearing machine.

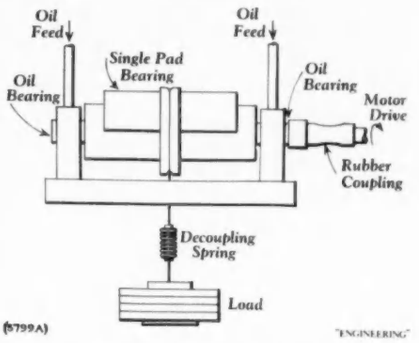

Fig. 1 Rig No. 1 with which the results shown in Fig. 2 were obtained.

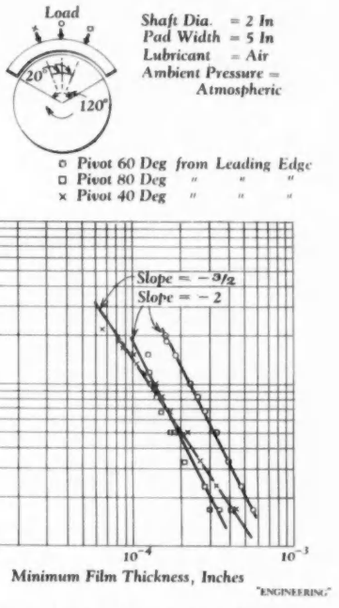

Fig. 2 Diagram showing the variation of minimum film thickness with load, speed and pivot position.

Clearly, a theory based on an incompressible fluid can only be valid if the compressibility of the gas can be neglected, i.e., the theory would be expected to be obeyed for load pressures small compared with the ambient gas pressure. In fact, the results agreed tolerably well for load pressures up to 50 per cent of the ambient pressure.

The experiments showed that a centrally-loaded pad runs with the greatest minimum gap, although quite large loads can be carried by pads pivoted forward or aft of the centre point. The centrally-loaded pad carried 63 per cent of the theoretical load on a plane slider of similar dimensions, running at the same minimum gap and lubricated by an incompressible fluid of the same viscosity. The relative speed was assumed to be the same and the slider was pivoted at the point of greatest load-carrying capacity, i.e., 0·58 of the bearing arc from the leading edge.

Pressures generated in the film were measured on mercury manometers connected to small holes in the bearing. Measurements were taken both in the direction of motion and perpendicular to it, for various loads and speeds. Some

Heat Transfer at High Gas Pressures

Part One

The introduction of nuclear power has created a need for research into boilers in which the critical Reynolds number is exceeded. This article describes work of this type done by Normalair Limited, Yeovil, Somerset.

Until the advent of nuclear power almost every power station boiler obtained its heat from the hot gases, partly by radiation and partly from convection, at sensibly atmospheric pressure. There were a few boilers operating on a high pressure gas cycle, but their use was mainly confined to special naval ships. There were also experimental or research stations dealing with coal gasification and heat transfer under high pressure conditions but their number was small.

With the introduction of nuclear power there was an immediate need for design and research work on boilers operating first with hot gas at about 10 atmospheres pressure and in the latest designs at about 20 atmospheres. Apart from work on aircraft heat exchangers, which bear little relation to power station boilers, practically no work had been done on high pressure gas heat transfer at high rates of mass flow.

The eddy flow pattern of gas around tubes obeys the laws of similarity with certain exceptions. That is to say, over a fairly wide range of velocities or mass flows or tube sizes, the eddy pattern remains constant and from a test under one set of conditions the heat transfer can be deduced for any other velocity, tube size, etc., within certain limits provided geometrically similarity is maintained. However, the eddy flow pattern is not constant at all velocities or rates of mass flow. At very low flow rates the flow pattern has almost no eddies and may be described as viscous or streamline while at very high flow rates the eddy pattern can change completely to a new form. The points of change of the eddy pattern depend on a function known as the Reynolds number, $\frac{\rho v L}{\mu}$. For values of this function below about 2,000 the flow is mainly streamline, between 2,000 and 100,000 the flow is normally turbulent with a constant eddy pattern and it is known from aircraft aerodynamic work that a change in the eddy pattern, and possibly a very drastic change, may be expected when the Reynolds number reaches about 200,000 or 300,000.

With atmospheric pressure boilers utilising conventional sizes of tubes the Reynolds number of the flow is above 2,000 and well below 100,000 so that heat transfer research and design on the hot gas side of the tubes is comparatively straightforward. However, immediately the gas pressure is raised to 10 atmospheres or above, as in the case of a nuclear boiler, the Reynolds number of the flow approaches and often exceeds 100,000; that is, it passes into the critical region where changes in flow pattern can be expected. Such changes may result in consequential and significant changes in the pressure drop and heat transfer coefficients. In order to optimise the design and to determine the working point for a bank of tubes it is necessary therefore to test them over a wide range of flows firstly to find out whether the laws of similarity hold over the design working range and secondly, if they do not, to determine the change point and whether it is better to work above or below it.

ATMOSPHERIC AND PRESSURE RIGS, OPEN AND CLOSED CIRCUITS

Research and development on the atmospheric pressure boiler in which the higher critical Reynolds number is never likely to be approached can be carried out on a simple type of open circuit atmospheric rig in which a fan with a power of only a very few horse power is sufficient to blow or suck air through a fair-sized bank of tubes. It is not even essential to test at the design rate of gas flow. However it is desirable to carry out tests at several flow rates so that effects such as fin conductivity, etc., may be determined. Tests at 3 or 4 rates of flow will suffice to give information from which the pressure drop and heat transfer coefficients can be deduced for any flow rate below a Reynolds number of about 100,000.

A simple atmospheric pressure rig cannot be used for the high critical Reynolds number ranges or at rates of mass flow corresponding to those used in the high pressure gas circuits of the latest nuclear boiler designs. At constant pressure and temperature the fan power required to blow or suck gas through a bank of tubes is proportional to the cube of the rate of mass flow. At constant mass flow but variable pressure the fan power required varies inversely as the square of the density. Thus at atmospheric pressure the fan power required would be 100 times that in a closed circuit rig at 10 atmospheres pressure or 400 times that in a closed circuit rig at 20 atmospheres pressure. In the latest high pressure gas circuits the flow rates may be of the order of 70,000 lb per sq. ft per hr. At atmospheric pressure and a temperature of 300° C the actual velocity corresponding to this flow rate would be some 500 ft per sec. Even if sufficient fan power were available to achieve this order of velocity through the tube bank, the compressibility effects on the eddy flow pattern might be appreciable, and the range of flow required to cover the high critical Reynolds number could not be achieved on an atmospheric rig without grave uncertainty as to the effects of this compressibility on the pressure drop and heat transfer.

Thus a high pressure rig is essential for heat transfer tests covering the upper critical Reynolds number range in which the designs for high pressure nuclear boilers may lie. Two basic types of high pressure facility are possible, these are the open circuit and closed circuit test rigs. Both types are used in the current series of experiments.

Briefly the open circuit high pressure rig (see Fig. 1) is suitable for obtaining quick results on small test sections; it is relatively cheap and quick to build but expensive to run. A closed circuit rig is more expensive and takes longer to build but once working, the fan power consumption is very low, and it is particularly suitable and economic for a long test series.

At Normalair Limited are air compressors having a total installed capacity of approximately 3,000 h.p. After drying to a water content of a few grains per lb., and being heated to a moderate temperature, their outputs can be fed into a common main. The total output available is approximately 20,000 lb per hour at pressures up to 250 lb per sq. in. For quick tests on small heat transfer specimens this air can be passed through the specimen under pressure to avoid compressibility effects and

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Concluding Journal Bearings with Gas Lubrication

values in the direction of motion at 3,000 r.p.m. are shown in Fig. 3. For a constant load, the pressures were found to be independent of speed, as predicted by the theory of a plane slider for an incompressible fluid. The position of the maximum pressure also agreed fairly well with this theory.

The pressures generated in a three-pad bearing were measured, and, from these measurements, the load on each pad was determined for various directions of the applied load. In this way, the theoretical result obtained by J. Boyd and A. A. Raimondi in 1953,[3] concerning the condition for greatest load-carrying capacity, was confirmed experimentally. Incidentally, their result showed that the greatest minimum gap obtains when the applied load on the shaft passes symmetrically between any two pivots. This result was confirmed in a more direct manner in a five-pad bearing of 5 in width and 2 in nominal diameter. The bearing, when running at 3,000 r.p.m., carried a maximum load of 80 lb before rubbing occurred, when the load passed directly through a pivot. While, when the load passed symmetrically between two pivots, a load of 93 lb was carried.

The experimental work culminated in the successful operation at 24,000 r.p.m. of a full-scale gas bearing machine (using rig No. 2, as shown in Fig. 4), consisting of a 22 lb rotor running on two sets of pivoted-pad journal bearings. This machine could have been readily adapted to provide the motor and bearing arrangement of a compressor, in which the bearings were lubricated by the circulating gas itself.

Theoretical Work.—The theoretical work consisted of a study of the various modes of vibration which a gas-lubricated pivoted-pad journal bearing was likely to exhibit. These vibrations were a result of the spring-like behaviour of the gas film. Thus, any mass in contact with the film, such as a pad, is bound to vibrate and ultimately to go into resonance, provided that some exciting force exists. Such an exciting force is provided by slight residual out-of-balance in the shaft, or surface irregularities.

Three main modes were distinguished, namely, a pad may vibrate about an axis through its pivot parallel to the shaft axis; a pad may vibrate about an axis through its pivot, which is mutually perpendicular to the shaft axis and the radius through the pivot; and the shaft (while itself remaining rigid) may whirl around in the bearing at rotational speed.

Formulae were obtained which express the resonant frequency of each of these modes, in terms of the fundamental bearing parameters. One general result of interest was that the resonant frequency for all three modes is inversely proportional to the cube of the radial clearance. The formulae are useful in that they enable an estimate to be made of the operating limits of a pad bearing of given design.

This article, which is published by permission of the managing director of the Industrial Group, United Kingdom Atomic Energy Authority, (where the author was a Scientific Officer) is a digest of the Authority's report No. IGR-R/CA-285, by the author, entitled *Pivoted-Pad Journal Bearings Lubricated by Gas* (HMSO, price 3*s* 6*d*).

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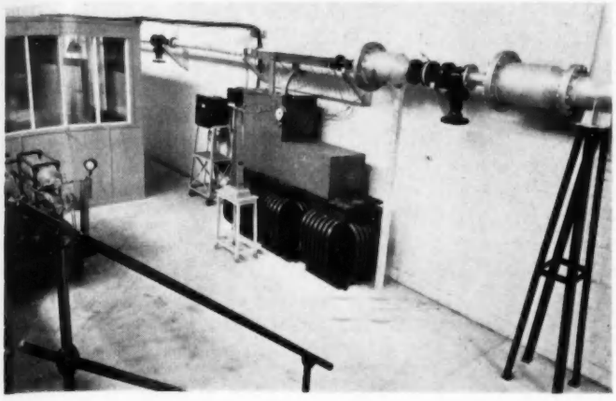


Fig. 1 Open circuit high Reynolds number rig, used to investigate effects of roughened surfaces on heat transfer.

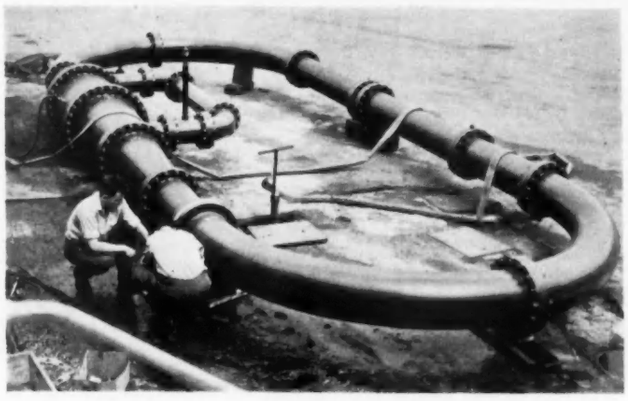


Fig. 2 Complete closed circuit rig under pressure test.

then blown down to waste. Even so the total quantity of air available is insufficient for tests on specimens of more than 10 to 20 sq. in cross-sectional area and could not be used to test a reasonable sized section of a bank of full sized boiler tubes. However, it could be used for a test with small scale model tubes, say a bank of $\frac{1}{4}$ in or $\frac{3}{8}$ in tubes instead of the full scale tubes of about 2 in diameter, and much information about the eddy flow patterns at the higher critical Reynolds numbers could thus be obtained.

The facilities are also particularly suitable for heat transfer tests on fuel element channels, etc., and work on these has been carried out at Reynolds numbers up to 2,000,000. Again the effect of roughened surfaces on the friction factor and on the Stanton number is being investigated.

A closed circuit high pressure rig is basically a high pressure loop contining a circulating fan, flow measuring equipment such as venturis or nozzles, a large capacity controllable heater or cooler, depending on whether the heat transfer is to be from the gas to the test specimen or vice versa, means for regulating the pressure by various devices such as a compressor for pumping up the rig and a controllable discharge valve and one or more detachable test casings into which can be assembled the test specimens together with connections for water or steam and instruments. In addition external services are required for heating or cooling the water, and controlling and measuring its flow rates.

The main factors affecting heat transfer between gases and tube banks are the rate of mass flow and the Reynolds number. The effects caused by differences in the physical properties of two gases such as air and carbon dioxide are minor ones, so that the case for testing with CO_2 is a weak one.

The use of CO_2 enormously increases the time, and hence the cost, of testing different tube banks, due to the extra work involved in detecting and sealing leaks. For instance when using air at a circulation rate of up to 190,000 lb per hour or 3,000 lb per min, a leak of 1 or 2 lb per min is immaterial. It simply means that the charging compressor must have a reasonable capacity and be kept running continuously throughout the tests. Such a leak rate with CO_2 is equivalent to a loss of between $\frac{1}{2}$ and 1 ton per day and this would be expensive. Experience at Normalair has shown that by using air a test specimen can be changed and the rig brought up to an acceptable leak rate in little more than a day. The time to achieve an acceptable leak rate when using CO_2 is measured in days.

Minor leaks frequently develop when the rig cools down between runs but seal themselves again after preliminary running prior to successive tests. Other more persistent leaks frequently develop at water pipe and instrument lead glands but these are usually small and forced shut downs due to leaks are very rare. On economy grounds such minor leaks would probably mean a shut down if CO_2 were used.

A closed circuit rig may be operated:

(*a*) By varying pressure at constant fan speed. With a maximum working pressure of 350 lb per sq. in the mass flow range is approximately 25/1. With this method the gas velocities everywhere throughout the rig are constant for any one test bank. Only the rate of mass flow and the Reynolds number change proportionally to the pressure. It requires a fair sized compressor attached to the rig so that the pressure can be changed rapidly. Its main disadvantage, though not a serious one, is that the gas velocity attained will be different for each test specimen, depending on its resistance, and as a result, one cannot test each tube bank at exactly the design conditions of pressure and mass flow. With the present rig a constant speed system would reduce the maximum rate of flow attainable by about 30 per cent.

(*b*) At constant pressure and variable fan speed. This would be the most economic system when using CO_2 but has the attendant disadvantage that in the range of low fan speed the pressure differences across the test banks and measuring venturis are exceedingly low and difficult to measure accurately.

(*c*) Variable pressure and variable fan speed. This is the system used in the present rig which can be seen in Fig. 2. The maximum rates of mass flow are obtained at maximum pressure and fan speed. An adequate range of flows can be obtained by reducing the pressure to atmospheric while still maintaining a moderate fan speed to give accurately measureable pressure differences and velocities.

To be continued

EXTRUSION PRESSURES REDUCED

The maximum pressure for a given impact extrusion process can be reduced by preforming a cone on the head of the billet. This is one of the conclusions from the first stage of an investigation into the cold impact extrusion of steels and non-ferrous metals carried out by the National Engineering Laboratory, East Kilbride, Glasgow. This technique is likely to be particularly useful in making extruded products which are normally outside the capacity of a press.

With a 60° cone angle on the billet and a 60° conical die entry, the pressure needed to extrude copper rod is 28 per cent less than that required to extrude a normal cylindrical billet through the same die.

The purpose behind this work is the study of the ways in which the varying ram speed of a crank press affects the extruded product in comparison with extrusion by a hydraulic press, which gives uniform ram speed throughout its stroke. It was found that, for low speeds, impact extrusion pressures were similar to those needed in a hydraulic press for a given reduction of aluminium, copper or brass. It was also found that extrusion pressure was related approximately linearly to the logarithm of the extrusion ratio (the ratio of billet cross-sectional area to product cross-sectional area) for aluminium, copper, brass, niobium, titanium and a range of steels. Tests involving large reductions from cold billets were successfully carried out, and the limit of reduction in most cases appeared to be imposed by the maximum permissible stress in the punch. Further information is given in Plasticity Report No. 138, available from the laboratory at the address given above.

WASHING HANDS

There are a number of techniques for preventing industrial dermatitis, but the simplest and most common of all is to wash frequently with a suitable cleansing agent. However, there are many different types of detergents and cleansing materials available and to assess the effectiveness of any one, especially in relation to a particular job, is always a difficult matter.

To overcome this problem, Alexander Duckham and Company Limited, Hammersmith, London, W6, have installed a small plant at their works which will enable a quantitative assessment to be made of the efficiency of any given cleansing agent. Basically this plant consists of a specially constructed glove box, incorporating washing facilities, in which radioactive isotopes can be handled safely.

To carry out a washing test a small quantity of carbon is labelled with a radioactive isotope, mixed with the dirt, and applied to a leather glove inside the box. A predetermined quantity of cleansing agent is then used to remove the dirt under running water, after which the glove is tested under a Geiger counter to measure the amount of tracer element remaining. The value of the radioactive count can then be used to obtain a quantitative assessment of the dirt remaining. When examining a cleansing agent it is subjected to five exactly similar tests, using an ordinary soap wash as a control datum.

Initial results with this equipment are said to have shown that Duckham's Hand Cleanser is about ten times better than ordinary soap, when used to remove oily dirt. Future research will cover the removal of contaminants encountered in the chemical and plastics industries.

MEETINGS AND PAPERS

Association of Supervising Electrical Engineers

LONDON
"Silicones," by K. J. Brimley. North London Branch. Wood Green Civic Centre, Town Hall, Wood Green, N22. Wed., 7 Oct., 8 p.m.
PRESTON
"Installation of Electric Lifts," by J. McEnery. Preston Branch. RAFA Club, East View, Preston. Wed., 7 Oct., 7.30 p.m.

British Institution of Radio Engineers

LONDON
"Some Reflections on Computer Design," by W. Renwick. Computer Group. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 7 Oct., 6.30 p.m.*
BRISTOL
Annual General Meeting. Chairman's Address on "The Drift of Electronics," by Captain L. Hix, RN. South Western Section. School of Management Studies, Unity Street, Bristol. Wed., 7 Oct., 6 p.m.
WESTON-SUPER-MARE
Symposium on "Training of Radio Apprentices." South Western Section. RAF Radio Apprentices School, Locking, Weston-super-Mare. Wed., 7 Oct., 10.30 a.m. to 4.30 p.m.

Helicopter Association

LONDON
"The Programme of Development Testing for a Helicopter," by T. G. G. Newbery. Royal Aeronautical Society, 4 Hamilton Place, W1. Fri., 9 Oct., 6 p.m.

Illuminating Engineering Society

LONDON
"The Nature of Light," by Sir Lawrence Bragg. Royal Institution, Albemarle Street, W1. Thurs., 15 Oct., 6 p.m.

Institute of Marine Engineers

LONDON
"Watchkeeping and Maintenance in a Motorship," by S. Speed. Student Lecture. Mon., 5 Oct., 6.30 p.m.* President's Address by Sir W. Wallace. Tues., 6 Oct., 5.30 p.m.
"Layout and Operation of Marine Steam Turbine Machinery," by D. M. V. Parkinson. Junior Lecture. Poplar Technical College, E14. Thurs., 8 Oct., 6.30 p.m.
LIVERPOOL
"Marine Alternating-Current Distribution Equipment, with Particular Reference to High-Rupturing Capacity Fuses," by M. J. Bolton. Merseyside and North Western Section, 9 The Temple, Dale Street, Liverpool. Mon., 5 Oct., 6 p.m

Institute of Metal Finishing

LONDON
"Some Notes on American Organic Finishing Practice," by W. Stein and A. A. B. Harvey. Organic Finishing Group. British Institute of Management, 80 Fetter Lane, EC4. Wed., 14 Oct., 6.30 p.m.

Institute of Petroleum

LONDON
"Piston Ring Friction: Rig Measurements with Low Viscosity Oils," by A. de Faro Barros and A. Dyson. Wed., 7 Oct., 5.30 p.m.*

Institute of Road Transport Engineers

BEDFORD
"A Review for the Selection, Specification and Design of a Commercial Vehicle," by E. B. H. Elsbury. Eastern Centre. Swan Hotel, Bedford. Tues., 6 Oct., 7 p.m.
CARDIFF
"Oil Additives," by A. Towle. South Wales Centre. South Wales Institute of Engineers, Park Place, Cardiff. Fri., 9 Oct., 7.15 p.m.
GLASGOW
"Development and Application of the 4-99 Perkins Diesel Engine," by H. L. Parish. Scottish Centre. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. Mon., 5 Oct., 7.30 p.m.
MANCHESTER
Film Evening. East Regional Centre. Houldsworth Hall, 90 Deansgate, Manchester. Mon., 5 Oct., 7.30 p.m.
NOTTINGHAM
"Transport Developments in the United States in 1957," by John F. Moon. East Midlands Centre. Mechanics' Institute, Nottingham. Wed., 7 Oct., 7.30 p.m.

Institution of Chemical Engineers

LONDON
"Controlled Crystallisation of Sodium Chloride," by Dr. J. Bain and Dr. F. Rumford. Geological Society, Burlington House, Piccadilly, W1. Tues., 6 Oct., 5.30 p.m.*

Institution of Electrical Engineers

LONDON
Inaugural Address of the President of the Institution, Sir Willis Jackson. Fri., 9 Oct., 5.30 p.m.* (Alteration of date.)
BIRMINGHAM
Annual General Meeting, and Chairman's Address, by G. F. Peirson, at 6 p.m., followed by a Conversazione at 7.30 p.m., for which tickets will be required. South Midland Centre. Grand Hotel, Birmingham. Mon., 5 Oct.
LEEDS
Chairman's Address on "Electrical Engineering at Redbrick University," by Professor G. W. Carter. North Midland Centre. Leeds and County Conservative Club, South Parade, Leeds 1. Tues., 6 Oct., 6.30 p.m.*
LIVERPOOL
"Development of the Telephone System in Great Britain," by T. A. P. Colledge. Mersey and North Wales Centre. Royal Institution, Colquitt Street, Liverpool. Mon., 5 Oct., 6.30 p.m.
LOUGHBOROUGH
Annual General Meeting, and Chairman's Address by D. H. Parry. East Midland Centre. College of Further Education, Loughborough. Tues., 6 Oct., 6.30 p.m.*
MANCHESTER
Chairman's Address, by F. J. Hutchinson. North Western Centre. Engineers' Club, Albert Square, Manchester. Tues., 6 Oct., 6.30 p.m.
PORTSMOUTH
Chairman's Address, by W. D. Mallinson. Southern Centre. Offices of the Central Electricity Generating Board, Portsmouth. Wed., 7 Oct., 6.30 p.m.

Institution of Engineering Designers

BIRMINGHAM
"Titanium and Its Alloys for Chemical Plant," by B. J. Connolly. Midlands Branch. Queen's Hotel, Birmingham. Wed., 7 Oct., 7.30 p.m.

Institution of Engineers and Shipbuilders in Scotland

GLASGOW
Inaugural Address by the President of the Institution, J. Brown. Tues., 6 Oct., 6.30 p.m.*

Institution of Heating and Ventilating Engineers

LONDON
"Packaged Boilers," by I. F. G. McVicker. Joint Meeting with the Institution of Plant Engineers. Royal Society of Arts, John Adam Street, Adelphi, WC2. Tues., 6 Oct., 7 p.m.*
Inaugural Address by the President of the Institution, H. C. Jamieson, on "A Variety of Engineering Experiences." Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Thurs., 8 Oct., 6 p.m.*
BRISTOL
"Engineering Services in the Empire Games Pool," by J. R. Kell. South Western Branch. RWA School of Architecture, Bristol. Tues., 6 Oct., 6.30 p.m.
NEWCASTLE UPON TYNE
"The Efficient Use of Fuel and Running Costs," by G. R. Winch. North East Coast Branch. Institute of Mining and Mechanical Engineers, Neville Hall, Westgate Road, Newcastle upon Tyne. Wed., 7 Oct., 6.30 p.m.
NOTTINGHAM
Problems and Experiences Night. East Midland Branch. College of Arts and Crafts, Waverley Street, Nottingham. Wed., 7 Oct., 6.30 p.m.

Institution of Mechanical Engineers

LONDON
Annual General Meeting. Chairman's report for the 1958-59 session and induction of the new chairman, at 6 p.m.* The chairman, L. H. Dawtrey, will deliver his inaugural address on "Some Problems We Meet" at about 6.30 p.m. Automobile Division. Tues., 6 Oct.
Inaugural Address by the President of the Institution, H. Desmond Carter, on "The Engineer, Life and Diesel Engines." Wed., 14 Oct., 6 p.m.*
COLCHESTER
"Materials for Astronautic Vehicles," by Professor A. J. Murphy. Eastern Branch. Red Lion Hotel, Colchester. Thurs., 8 Oct., 7.30 p.m.
LEEDS
"Power Transmission," by T. Hall. Yorkshire Branch. The University, Leeds. Thurs., 8 Oct., 6.30 p.m.
LEICESTER
"The Importance of Biomechanics as a Service to Man, Illustrated by a Discussion of Problems in Metallic Osteosynthesis," by J. Zarek. East Midlands Branch. College of Technology, Leicester. Wed., 7 Oct., 7.15 p.m.
MANCHESTER
"Corrosion-Resistant Coatings and Linings," by V. Evans. North Western Industrial Administration and Engineering Production Group. Engineers' Club, Albert Square, Manchester, 2. Thurs., 8 Oct., 6.45 p.m.

Institution of Mining and Metallurgy

LONDON
"Removal of the Coarser Solids from Underground Water at the Bancroft Mine," by D. F. Kelsall and J. A. Holmes; "Simple Method of Estimating the Resistance to Airflow in Any Shaft Section," by J. C. Anderson; and "Economic Factors in the Design and Operation of Underground Ventilation Circuits," by M. J. West. Geological Society, Burlington House, Piccadilly, W1. Thurs., 15 Oct., 5 p.m.*

Institution of Naval Architects

LONDON
"The Prospect for a Nuclear-Powered Dry-Cargo Liner," by Dr. E. C. B. Corlett and E. P. Hawthorn. Wed., 7 Oct., 4.45 p.m. (Alteration of date.)

Institution of Plant Engineers

LONDON
"Packaged Boilers," by I. F. G. McVicker. Joint Meeting with the Institution of Heating and Ventilating Engineers. Royal Society of Arts, John Adam Street, Adelphi, WC2. Tues., 6 Oct., 7 p.m.*
COVENTRY
Brains Trust on Members' Problems and Ideas. Birmingham Branch. Hotel Leofric, Coventry. Fri., 9 Oct., 7.30 p.m.
EDINBURGH
"Changes in Factory Legislation," by A. Gow. Edinburgh Branch. 25 Charlotte Square, Edinburgh. Tues., 6 Oct., 7 p.m.
NEWCASTLE UPON TYNE
"Recent Developments in Steelmaking Process," by Dr. S. G. Cope. North East Branch. Roadway House, Oxford Street, Newcastle upon Tyne. Thurs., 8 Oct., 7 p.m.
PETERBOROUGH
"The Diesel Electric on British Railways," by C. Morris. Peterborough Branch. White Lion Hotel, Church Street, Peterborough. Tues., 6 Oct., 7.30 p.m.
SOUTHAMPTON
"Town Planning and the Location of Industry," by Roland J. Roddis. Southern Branch. Polygon Hotel, Southampton. Wed., 7 Oct., 7.30 p.m.

Institution of Production Engineers

LONDON
"Properties and Applications of Modern Precision Grinding Machines," by J. Manning and R. Barton. London Graduate Section. Tues., 13 Oct., 7.15 p.m.
ARBROATH
Discussion on "Numerical Control of Machine Tools." Dundee Section. Windmill Hotel, Arbroath. Wed., 7 Oct., 7.30 p.m.
COVENTRY
Discussion entitled "Concerning Gleason Methods and Machines." Coventry Graduate Section. Craven Arms, High Street, Coventry. Tues., 6 Oct., 7.15 p.m.

Institution of Structural Engineers

BELFAST
"Prestressed Concrete Manufacture and Construction, with Special Reference to a Factory in Northern Ireland," by K. Brown. Northern Ireland Branch. Civil Engineering Department, Queen's University, Belfast. Tues., 6 Oct., 6.30 p.m.
BRISTOL
Chairman's Address by Peter Gardiner. Western Counties Branch. Engineering Laboratories, The University, Bristol. Fri., 9 Oct., 6 p.m.
MIDDLESBROUGH
Chairman's Address by W. R. Garrett. Northern Counties Branch. Cleveland Scientific and Technical Institution, Middlesbrough. Thurs., 8 Oct., 6.30 p.m.
NEWCASTLE UPON TYNE
Chairman's Address by W. R. Garrett. Northern Counties Branch. Neville Hall, Westgate Road, Newcastle upon Tyne. Tues., 6 Oct., 6.30 p.m.

Junior Institution of Engineers

LONDON
"Some Aspects of Space Heating," by D. E. Edminson. Fri., 9 Oct., 7 p.m.*

Liverpool Metallurgical Society

LIVERPOOL
Presidential Address on "The Production and Use of Steel Wire and Steel Wire Ropes," by B. Ryan. Department of Metallurgy, University of Liverpool, 146 Brownlow Hill, Liverpool 3. Thurs., 15 Oct., 7 p.m.

Manchester Association of Engineers

MANCHESTER
Inaugural Address by the President of the Association, M. Bentham, followed by a smoking concert and film display. Engineers' Club, Albert Square, Manchester. Fri., 9 Oct., 6.45 p.m.

Newcomen Society

LONDON
Annual General Meeting. "Davies Gilbert, Patron of Engineers (1767-1839) and Jonathan Hornblower (1753-1815)," by Dr. A. C. Todd. Wed., 7 Oct., 5.30 p.m.

Royal Statistical Society

CARDIFF
"Industrial Simulation by Computer," by Dr. K. D. Tocher. South Wales Group. Park Hotel, Cardiff. Thurs., 8 Oct., 6.30 p.m.

Society of Engineers

LONDON
"Compressed Air in Coal Mines," by Neville Smith. Geological Society, Burlington House, Piccadilly, W1. Mon., 5 Oct., 5.30 p.m.*

Society of Instrument Technology

BIRMINGHAM
"Methods of Testing Electrical Equipment Used in the Car Industry," by P. Luckhurst. Midland Section. Gosta Green College of Technology, Aston Street, Birmingham. Fri., 9 Oct., 7 p.m.
CHELTENHAM
"Record Reproduction Equipment," by E. W. Mortimer. Cheltenham Section. Belle Vue Hotel, Cheltenham. Mon., 5 Oct., 7.30 p.m.
MANCHESTER
"Instrumentation in the Textile Industry," by L. H. C. Tippett. Manchester Section. Central Library, St. Peter's Square, Manchester 1. Tues., 13 Oct., 6.45 p.m.
SHEFFIELD
"Continuous Casting at Barrow," by I. M. D. Halliday. South Yorkshire Section. The University, St. George's Square, Sheffield 1. Mon., 5 Oct., 7 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. Particulars for this feature should reach the Editor at least three weeks before the date of the meeting.

* An asterisk is placed where it is understood that refreshments are available prior to the time stated.

Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London, WC1. (LANgham 5927.)
British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901.)
Helicopter Association of Great Britain, 4 The Sanctuary, London, SW1. (ABBey 5160.)
Illuminating Engineering Society, 32 Victoria Street, London, SW1. (ABBey 5215.)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London, EC3. (ROYal 8493.)
Institute of Metal Finishing. Apply to 11A Gloucester Road, London, SW7. (KNightsbridge 9181.)
Institute of Petroleum, 61 New Cavendish Street, London, W1. (LANgham 3583.)
Institute of Road Transport Engineers, 69 Victoria Street, London, SW1. (ABBey 6248.)
Institution of Chemical Engineers, 16 Belgrave Square, London, SW1. (BELgrave 3647.)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871.)
Institution of Engineering Designers, 38 Portland Place, London, W1. (LANgham 8847.)
Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. (Central 5181.)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158.)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476.)
Institution of Mining and Metallurgy, 44 Portland Place, London, W1. (LANgham 3802.)
Institution of Naval Architects, 10 Upper Belgrave Street, London, SW1. (SLOane 4622.)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469.)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254.)
Institution of Structural Engineers, 11 Upper Belgrave Street, London, SW1. (SLOane 7128.)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London, SW1. (VICtoria 0786.)
Liverpool Metallurgical Society, Greenhithe, Grosvenor Road, St. Helens, Lancs. (St. Helens 5879.)
Manchester Association of Engineers, 18 Booth Street, Manchester 2. (Central 1717.)
Newcomen Society, Science Museum, Exhibition Road, London, SW7. (KENsington 1793.)
Royal Statistical Society, 21 Bentinck Street, London, W1. (WELbeck 7638.)
Society of Engineers, Abbey House, Victoria Street, London, SW1. (ABBey 7244.)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251.)

On the Shelf

By Frank H. Smith

A most elaborate and quite bulky publication has been received from the Co-operative Society for Geodesy and Cartography, Frankfurt am Main, Forsthausstrasse 151. It is called *Geodesy and Cartography* and is intended to help those responsible for big contracts who require advice in these spheres. The seven sections are: geodetic surveying, photogrammetry, engineering projects, cartographic work, reproduction and printing of maps, geophysics, miscellaneous. Each section has a preamble by an authority in the field and advertisers' wares follow as they apply. It must have cost a small fortune to produce and, as far as I know, it is there for the asking. Strangely enough, while the text is in English, the introductory letter is in German. I see DM6 mentioned towards the end so perhaps it is not free after all. But what's 10*s* to the sort of people to whom this will apply?

Interested in hydroelectric power? There is a select bibliography available (covering 1928-59) from the Technical Library, Tennessee Valley Authority, Knoxville, Tennessee. All references in English.

Numbers 1/2 and 3 (like that, with 1 and 2 together) of *Powder Metallurgy* have been issued by the Powder Metallurgy Joint Group of the Iron and Steel Institute and the Institute of Metals. Those two do a lot of joint business. Their library is a joint library (whereupon we make corny jokes about legs of mutton on the shelves) but such cooperation shows a nice team spirit and certainly benefits the customer. However, to return to our metallurgy: the group was formed in 1957 and in a year its membership (exclusive to the two Insts.) was over 900. Two meetings a year are contemplated, one devoted to industrial applications and the other to research. Papers read appear in the periodical I mentioned, *before* discussion. The discussion goes into the following issue. Am I clear? If, from this, you assume that *Powder Metallurgy* will appear twice a year, you're right by Jiminy. If you're a non-member it costs 25*s* a year. If you are a member you'll know all about it.

How's your German? From Vienna (Wien to you), Mollardgasse 8, to be exact, comes a new journal *Neue Physik*, subtitled *Zeitschrift für die Gebiete der Atom-und Strahlungsphysik*, if that helps. It costs DM2 a number or DM10 for the year's six *hefte*. The first two numbers seem to be the monopoly of a Mr. K. Nowak whose papers (three) there are nothing else but. I think the editor is K. Nowak. Perhaps he'd like to hear from somebody else?

For those interested in old books, an interesting little catalogue (No. 18) of scarce books comes from Mr. W. A. Lee of 162 Byres Road, Glasgow, W2. Can't stop to select titles so you'd better drop him a card.

Another contribution to those who collect new terms. A headline in a recent *Aviation Week* read "USAF Investigates Basic Moletronics." Molecular electronics to those of you who do not trade in portmanteaux.

Have I offered you this American publisher's address in London before? Addison Wesley at 10-15 Chitty Street, W1 (MUSeum 3273). They have a 32-page catalogue called "Scientific and Engineering Books" with a pink insert which has, among other things, a table of suggested books for various levels of knowledge of the subjects of mathematics, physics and engineering sciences.

I do not know how booksellers feel about it but Robert Hale Limited (63 Old Brompton Road, London, SW7) send me a postcard advertising new books with the heading "September 2nd is the day to get these novels from your Library." I suppose the idea is that you ask at your library and the immediate frustration sends you scuttling off to your bookseller.

PLENTY OF ROOM INSIDE

The Structure and Properties of Porous Materials. Edited by D. H. Everett and F. S. Stone. Proceedings of the 10th Symposium of the Colston Research Society held in the University of Bristol from 24-27 March, 1958. *Academic Press Incorporated, New York, USA* ($12·00); and *Butterworths Scientific Publications, 4 and 5 Bell Yard, London, WC2.* (60*s*)

Russia and the United States, Australia, Canada and six European countries were represented at the symposium recorded in this book. About half the text is taken up by the eighteen papers presented, and the remainder is a very lightly edited transcript of the tape recorded discussion. This is refreshingly informal and gives many details of technique and experience from sources not usually available. The reviewer was present at the symposium and can vouch for the way in which the spirit of the interchanges has been kept.

Any symposium runs the risk of becoming an assembly of specialists, each looking through his own window. The Colston symposium avoided this trap by concentrating three quarters of its time on the ultimate aim of all the specialists: an understanding of the fundamental geometry and molecular structure of the interior surface of a porous body, sufficiently detailed to account for all observations. This goal has been approached along many roads, the principal ones being adsorption of vapours, heat of wetting by liquids, electron microscopy, X-ray diffraction, electrochemistry, gas flow and penetration by a non-wetting liquid such as mercury. Only the main lines of attack described in the papers can be outlined here.

The specialists in crystal structure describe the cages and networks of channels in which small molecules can move with somewhat restricted freedom. The concept of surface breaks down at these levels, and the individual atoms or groups must be thought of as a three-dimensional pin table. The adsorption workers give remarkable graphs (isotherms) of the take-up and release of adsorbate as the partial pressure is raised and lowered, and explain these in terms of the deposition of monomolecular layers, followed by further layers and finally by capillary condensation of liquid, in pores of diverse shape and size. In this approach a pore is assumed to possess an effective surface, but its curvature is critical since it controls the vapour pressure in equilibrium with the surface. To explain the observed hysteresis in take-up and release the proposed structures range from tubular and slit-like pores to "ink bottle" shapes and the spaces between crossed bundles of rods.

In adsorption on silicates the surface chemistry and the local electrostatic forces are important; and in some models of carbon the simplified picture of chemical bonds between spherical atoms must be extended to electron orbitals to give the correct thickness to the benzene rings from which the model is built. All these effects become significant in pores smaller than 10^{-6} cm (micropores); but much of the practical efficiency of porous substances in technology depends on their macropores, arbitrarily taken as greater than 10^{-6} cm in diameter.

Some gases are able to move through artificial fine-pore charcoal by surface diffusion through the adsorbed layer, but in general it is possible to explain gas flow as a combination of molecular interaction (viscosity) and molecular diffusion through capillaries. The pore size required to explain gas flow is not usually consistent with the other properties, and it is necessary to visualise a statistical model of "rooms and doors," with various modes of interconnection. These properties are vital in the technology of gas treatment and it is the macropores from 10^{-6} cm upward which control the flow, though the micropores are responsible for the adsorption.

In textiles the swelling of the fibres, on adsorption of organic molecules or water, affects both their affinity for dyes and their macrostructure. Thus comfort and application are directly influenced by the molecular nature of the internal surface of the fibres.

Similar practical effects are observed in paper making, and in the breakdown under frost of building stone, and phenomena of this scale are held responsible for raising the 100 ft column of sap up a tall tree. Contributions on textiles paper, stone and botanical pore structures were included in the symposium.

For the specialist in the fundamentals of adsorption or the structure of materials of high internal surface, the book will be a valuable reference to theoretical and practical methods of approach by other workers. To the engineer concerned with the effects of humidity or organic vapours on his materials, the papers with their discussions and bibliographies will form a direct entry to the fundamentals of the subject. Adequate indexes, both by subject and author, are provided.

P. K. C. Wiggs

TEXT BOOKS TOGETHER

Theory of Machines. By Bevis Brunel Low. Third Edition. *Longmans, Green and Company Limited, 6 and 7 Clifford Street, London, W1.* (25*s*)

Harriet Beecher Stowe in her book *Uncle Tom's Cabin* introduces a character Topsy who "just growed." Successful textbooks, like Topsy, often start in a small way and over the years they grow. This book has done just that. It started in 1942 under the title *Engineering Mechanics*, and after four impressions was issued in 1954 as a new 2nd edition with eight additional chapters under the title *Theory of Machines*. The 3rd edition recently issued and now being reviewed has two further chapters. The effect of repeated production of the book is to give the purchaser very good value for money, and it costs only 25*s*.

The presentation of the subject matter is good and is very readable. The choice of material to illustrate the principles of mechanics is practical and several matters which are not in other text books are included. For example an analytical treatment of external-contacting pivoted-shoe brakes is given. The book has a number of worked out examples and each chapter has exercises provided. Unfortunately the answers to these are placed at the end of the book as if they were really meant to be a secret.

B. B. Low is an author of several text books and in this is following the example of his father, Professor D. A. Low, whose books are still widely known. His principal addition to this edition is on the subject of vibrations. Two new chapters have been added, one on torsional oscillations and the other on advanced spring and pendulum problems. These additions are well in line with the modern trend of teaching more vibration theory under the subject title theory of machines. The book is now a curious mixture of the simple and the complex. For instance the first chapter opens by stating the Greek alphabet; what could be more fundamental than that? It continues with kinematics and is soon dealing with the somewhat complex analysis of Hooke's Joint which incidentally, is one of the extras in this edition. The conventional topics such as analysis of cams, friction, flywheels and belt drives follow until, about half way through the book, after the reader has

demonstrated considerable mathematical ability in following the text and solving the exercises, he is brought back to a basic fact stated quite boldly that "$e = 2{\cdot}71828$ . . . and is the base of Napierian logarithms"!

However, the book is ideally suitable for students taking the Ordinary and Higher National Certificates and is useful for some university examinations. It is now a good general text book on theory of machines developing the subject on sound principles to a standard sufficient for those requiring a general education in mechanical engineering.

Solution of Problems in Theory of Machines. By S. ANVONER. *Sir Isaac Pitman and Sons Limited, Pitman House, Parker Street, Kingsway, London, WC2.* (35*s*)

It is now a common practice among teacher of engineering subjects to instruct students having limited mathematical ability by using a book of worked examples and exercises as a supplement to lectures. Such a book can give by illustration the application of formulae derived apparently so easily by the lecturer, and can give students a feeling of confidence in the subject.

The first edition of *Solutions of Problems in Theory of Machines* is a book containing 203 fully worked out examples together with 285 exercises with answers. It might well have been entitled "Solutions to London University B.Sc. (Eng.) Examination Papers in Theory of Machines over the Past 20 Years." The author is a lecturer at Woolwich Polytechnic which is an old established institution of very high standing within the framework of London University. The book is intended for students preparing for Higher National certificates in engineering, Diplomas in Technology, and the final London University B.Sc. (Eng.) degree. In many ways it is admirable for this purpose. It is hoped that the book will be useful for students preparing for final examinations of other universities. Useful no doubt it will be, but in a number of universities now the emphasis in the teaching of theory of machines is on vibrations and control systems. For studies directed in this way the book is inadequate. It contains, for instance, no mention of the solution of vibration problems by the use of rotating-vector phase diagrams. This is a pity in a book which will be largely used by students comparatively weak in mathematics, and to whom a "picture" solution appeals more than a lengthy differential equation solution.

As has become the custom in books of this type, each topic is introduced by abridged theory. This is most useful for reference purposes and for examination revision. Students buy few books these days and to many a book of examples such as this will be the only personal book on the subject. The addition of a bibliography giving references to standard and more comprehensive works would have been most valuable. One fault which stands out to the reviewer is the failure to incorporate in a new book a system of symbols which indicates the distinction between force and mass units. The use of the Stroud System as suggested in B.S. 1991, Part 1, 1954, in which the capital initial is used for force units (for example Lb), and a lower case initial for mass units (as lb), would have been easy to incorporate and would have avoided many a difficulty over the gravitational constant g.

These faults are however a matter of opinion. The book as a whole is a good one having a wide selection of examples, very full solutions and is well presented. It is certain that the book, which is more comprehensive than others in the same field, will be a great help to students and their instructors in covering the conventional theory of machines syllabus.

N. S. GRASSAM

STRUCTURAL STABILITY

Stabilitätstheorie. By GUSTAV BÜRGERMEISTER and HERBERT STEUP. *Akademi-Verlag, Mohrenstrasse 39, Berlin W8, Germany.* (35·50 *DM*)

These 400 pages form the first volume of a comprehensive treatment of stability problems, and the contents can perhaps best be illustrated by listing the design examples which comprise the last quarter of the book: (1) cantilever with elastic support; (2) diagonal compression bracing member (battened channels); (3) T-section bracing of crane column; (4) compression member of non-uniform section; (5) tapering column; (6, 7) design of batten plates; (8) design of battened column; (9, 10, 11) roof truss; (12) braced square column; (13, 14, 15) stability calculations for built-up sections (lateral stability); and (16, 17, 18) stability of deep beams. The section of the book dealing with approximate methods is particularly good, and five different methods are used to find the solution of design example (5).

The introduction gives a brief but lucid classification of the classes of stability problem, and draws attention to overall structural instability, in which the whole structure, rather than one compression member, participates in unstable deformation. Mention is also made of complications arising when partial plasticity is developed. This brief description omits the all important fact that the authors approach the subject in the traditional way; thus, Euler's equations still form the basis of the simple buckling equations, even though these are modified by the results of modern theories, and are solved by the use of modern numerical techniques. The quantities calculated, in fact, may in some cases have little correlation with the behaviour of a member in an actual structure. It is clear, for example, that a simple equation does not suffice for the calculation of the buckling load of a partially restrained column in a building frame; no theory which does not take into account bending about both axes, stiffness about both axes, and, most importantly, torsional rigidity, can be said to describe accurately the phenomenon of instability.

However, taking into account this (reasonably severe) limitation, the book is a useful and thorough exposition of buckling calculations made in current practice.

JACQUES HEYMAN

TRADE PUBLICATIONS

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Electrodes. ENGLISH ELECTRIC CO. LTD., Clayton-le-Moors, Accrington. Hermees electrodes for fast welding heavy sections in mild and alloy steels. From 12 gauge to $\frac{5}{16}$ in dia. Composition and deposition speeds. Publication WA/141.

Manipulators and Fixtures. YATES PLANT LTD., Whidborne Street, London, WC1. Manipulators, clamping fixtures, and mechanised welding shop plant. Various leaflets.

Welding and Cutting. D. S. BADDELEY ENGINEERING CO. LTD., 43-45 York Street, Glasgow, C2. Oxy-acetylene welding cutting and heating torches, regulators, electric welding transformers, fluxes, etc. Illustrated catalogue and price list.

Epoxy Resins. CIBA (A.R.L.) LTD., Duxford, Cambridge. Charts showing the methods of use of Araldite epoxy resin adhesives in conjunction with various materials. Folder.

Aluminium Jointing. IMPERIAL CHEMICAL INDUSTRIES LTD., Millbank, London, SW1. Kynal aluminium busbar jointing compound, its properties and methods of use. Booklet.

The Reviewers

Mr. P. K. C. Wiggs is project leader in the central research department of the Morgan Crucible Company Limited, and was responsible for the design of the mercury porosimeter now adopted by several laboratories for pore size analysis of carbon. He is an M.A. of Cambridge, obtaining first class honours in the Mechanical Sciences Tripos, and is an associate member of the Institution of Electrical Engineers.

Dr. N. S. Grassam is a lecturer in Mechanical Engineering at the University of Southampton, where he has prime responsibility for the nuclear engineering lectures. Prior to going to Southampton in 1951 he was a Senior lecturer in engineering at the Royal Naval College, Greenwich. He is a Ph.D., a B.Sc., an A.M.I.C.E., and an A.M.I.Mech.E.

Dr. Jacques Heyman is a university lecturer in the Department of Engineering, University of Cambridge, and in 1957-58 was visiting professor at Brown University in the United States. He is an M.A., a Ph.D., and an associate member of the Institution of Civil Engineers. He was author of *Plastic Design of Portal Frame* and coauthor (with J. F. Baker and M. R. Horne) of *The Steel Skeleton Vol. II.*

NEW BOOKS

Practical Metrology. Vol. III. By K. J. HUME and G. H. SHARP. *MacDonald and Company Limited, 16 Maddox Street, London, W1.* (10*s* 6*d*)

The third of four volumes. The chapters are headed, as before, "Experiments," of which there are 12 with such titles as "To set and calibrate an engineer's block level"; "To calibrate a dial gauge," etc., etc. A short bibliography which includes six British Standard specifications indicates a dearth of literature.

Principles and Practice of Radar. By H. F. PENROSE and R. S. H. BOULDING. Sixth Edition. *George Newnes Limited, Tower House, Southampton Street, WC2.* (50*s*)

In the sixth edition—the first was published in 1949—details of marine true motion radar, the cosecant squared aerial, and the use of circular polarisation to minimise rain interference have been added. The section describing commercial equipment has been extended; and developments such as lenses and slot aerials have been included.

The Prediction of Ballistic Missile Trajectories from Radar Observations. By IRWIN I. SHAPIRO. *McGraw-Hill Book Company Incorporated, 330 West 42nd Street, New York 36, N.Y. USA;* and *McGraw-Hill Publishing Company Limited, 95 Farringdon Street, London, EC4.* (54*s* 6*d*)

A report from MIT, first published in 1957 and later reissued. In general, the different radar measurements on a missile provide more data than are necessary to dynamically specify the trajectory; and as the data are often corrupted by noise, statistical decision techniques are needed. In the report it is assumed that the detection phase of processing radar signals has taken place. The problem of distinguishing between returns from several targets is not considered. Prime consideration is given to maximum likelihood parameter estimates.

The Conversion of Ionospheric Virtual Height-Frequency Curves to Electron Density-Height Profiles. By J. O. THOMAS and M. D. VICKERS. Radio Research Special Report No. 28. *Published for the Department of Scientific and Industrial Research by Her Majesty's Stationery Office, York House, Kingsway, London, WC2.* (3*s* 6*d*)

Describes an electronic digital computer programme for calculating distribution of electron density with height from experimental virtual height-frequency records. Allows for earth's magnetic field effect. 48 pages, extensive bibliography.

On the Theory of Fading Properties of a Fluctuating Signal Imposed on a Constant Signal. By H. BREMMER. National Bureau of Standards Circular 599. *Superintendent of Documents, US Government Printing Office, Washington 25, DC, USA.* (25 cents)

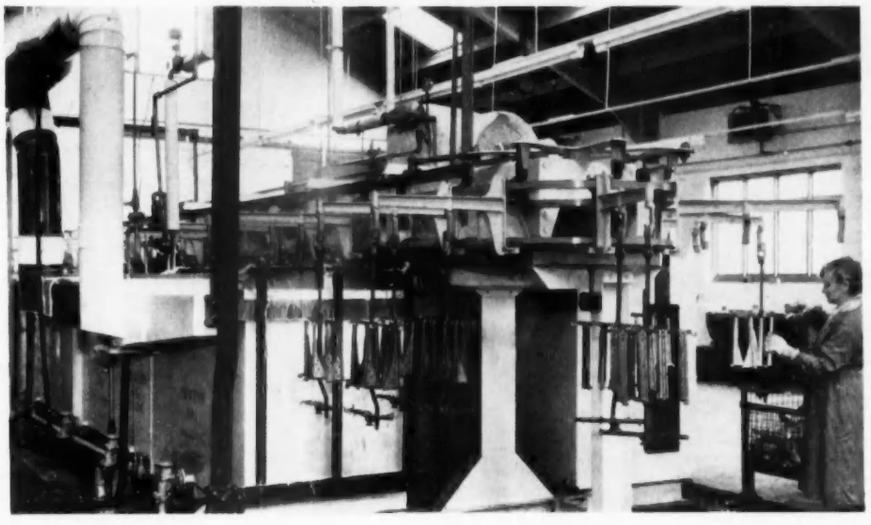
"Deals with a theoretical investigation of the fading properties of a signal composed of a fluctuating contribution and another steady contribution with fixed amplitude and phase." 32 pages, 9 references. The author is from N. V. Philips Res. Labs. at Eindhoven.

Improved Plating with Automatic Plant

With automatic plant, deposits may be guaranteed with confidence to satisfy specifications. Advances in zinc and cadmium plating include the bright deposit, which may be further improved by passivation in a chromate bath.

By L. N. Sinclair

Modern Electro Plating (Kent) Co. Ltd.

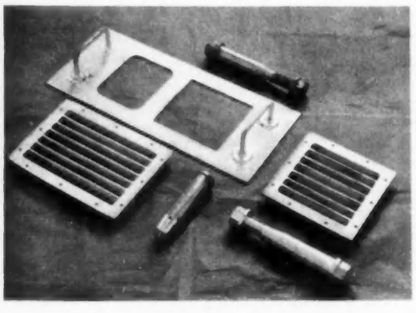


Loading and unloading end of an automatic plating unit.

Electrodeposited coatings of zinc or cadmium offer good corrosion protection for steel components, and the development of automatic plating plant in recent years is allowing improved coatings to be obtained at lower cost on a much wider range of products.

In general, automatic plating processes have replaced hand plating ones in industries where mass production techniques are employed. This change has taken place chiefly because of the rate and quantity of output that is possible with automatic plants, together with associated reductions in labour requirements. Where protective electrodeposits such as zinc and cadmium are involved, considerable reductions in the cost of plating each article can also be achieved with automatic plant. Accurate costing is also much easier to carry out, as the human element is eliminated. Components weighing over 1 lb can be handled much more effectively in an automatic plant than in a hand plant, where the operators tend to tire in the course of a working day—one of the factors involved in sub-standard coatings. Heavy machined components are also apt to be damaged in hand plating plants.

Considerable advances in the design of automatic plating plants have been made in recent years. Current types are far more compact, much less complicated and a great deal easier to maintain—often by semi-skilled workers. It is also quite common for female labour to operate this type of plant, subject to the makeup of the baths being controlled by a chemist. It should also be appreciated that, in comparison with the average hand plating shop, working conditions where automatic plant is in operation are much cleaner and less noisy. Much faster rates of deposition are possible because of the higher amperages that can be used in the denser solutions that have recently been developed. On



These are typical building parts which it is economical to plate automatically.

the other hand careful thought needs to be given to the design of the jigs on which components are hung for plating, as a badly designed jig can cut down output very considerably.

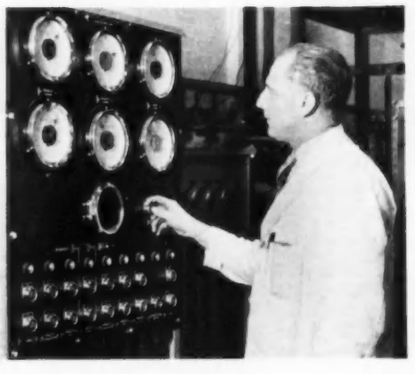
There are several reasons why parts that have been plated in automatic plant are better protected than those that have been treated in hand plants. Any thin areas in the coating, for example, can be eliminated by redesigning the jigs upon which the parts are hung. The controlled rate of deposition ensures that all deposits are the same, and there is no risk of damage to coatings through mishandling. In addition, the cleaner conditions of the automatic plating shop avoid contamination that could affect deposit properties.

Zinc and cadmium plating baths that produce a bright rather than a dull or matt deposit are another important development that has taken place lately. Bright and dull electrodeposits of zinc and cadmium have generally the same protective qualities. In some respects, however, bright deposits are superior. They do not fingermark, for example, and are closer grained as well as slightly harder. As well as being decorative in appearance, bright deposits of zinc and cadmium will in some cases reveal defects in the basis metal which would have been hidden by dull coatings but which might have appeared when the plated components were in service.

The chief advantage of a zinc coating, of course, stems from the mechanism by which it protects basis steel. The zinc coating, as it corrodes, becomes covered with a grey adherent corrosion product, which itself holds up further attack for some time. When this is finally pierced, a small cell is formed in which the anodic zinc and the cathodic steel are electrically connected by the environment: the zinc is gradually dissolved but the underlying steel is protected by this sacrificial action. Zinc coatings may be produced by galvanizing as well as by plating of course, but in general it can be said that zinc plated coatings are more ductile than galvanized ones, are extremely uniform and have a particularly fine finish. The low temperature at which plating plants operate may also be of advantage in certain applications. The same sacrificial effect that protects the basis metal is found with cadmium as with zinc, but cadmium is particularly suitable for use on parts subjected to marine corrosion: in certain acid industrial areas, a zinc coating will give better service than a cadmium one however. A bright cadmium coating is of silvery appearance, much like silver plate, in fact, and for certain applications, particularly where no paint is applied, may be preferable to the bluish tinge of a zinc deposit. A cadmium deposit will also retain its original colour, whereas zinc will darken considerably on exposure. The deposit is a denser one than zinc and more compact, and has the valuable feature that it is unaffected by alkalies.

The life of cadmium plate under many conditions can be improved by chromate passivation. The normal passivation process (DTD 923) produces an iridescent effect which may be undesirable for certain purposes: this can be replaced by Silvertone bright passivation which leaves a brilliant silver surface and does not fingermark. This bright passivation can also be used as a base for paint, as it provides good adhesion for the paint film and protection from underfilm rusting. The process is best carried out on a deposit of at least 310-thous thickness.

While bright zinc and cadmium coatings can be deposited in manually operated plating plant, therefore, the use of modern automatic plating plant enables reduced prices, better finishes, quicker deliveries, massive output and guaranteed



Centralised control helps give uniform and reproducible deposits, which enables them to be guaranteed.

deposits to be achieved. Reduced prices mean that in some cases a saving of as much as 50 per cent of the cost of manually processed parts can be achieved. Finishes of more attractive appearance which are completely standard in batch quantities and are unmarked by handling can be offered, and quicker and more reliable deliveries of plated work can be made, since it is possible to process components with the automatic plant in about a quarter of the time needed for manual operations. Finally, automatic plating permits a guaranteed deposit to be produced, particularly to specifications DTD 904 and BSS 1076, since strict control can be ensured through all stages of the plating process.

STRONG POLYMERS

A strength of 3 million lb per sq. in for a plastics material—just ten times that of the highest strength steel—sounds like a theoretical prediction. Unfortunately, it is, but as Professor Hermann Mark of the American Polymer Research Institute pointed out in his Marburg lecture to the ASTM annual meeting, fibres of polyethylene have already exhibited strengths of 200,000 lb per sq. in and nylon 160,000. Remember then their low density.

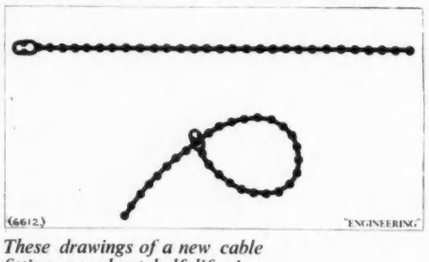
These high strengths were obtained in polymers whose molecules lie parallel to one another, such as in fibres and thin sheets. Professor Mark went on to trace the work of Ziegler and Natta in Italy which had led to the production of molecules which were further ordered in the arrangement of their individual atoms. These exhibit higher strengths and melting points than their less orderly cousins.

In the effort to synthesize polymers having high rigidity at elevated temperatures, polymer chemists are experimenting with new combinations of atoms, including some of the metals such as aluminium, magnesium and tin; one such polymer melts at 450° C; another—polyacrylonitrile, or the so-called " black Orlon "—will glow but not burn.

The gaps between polymers, metals and ceramics are definitely narrowing—both in properties, and underlying science.

CABLE BINDERS

These rather jolly worms—call them what you will—are cable fittings, and are made in a tough thermoplastic said to withstand 105° C. The makers are Hellermann Limited of Crawley, Sussex, who sell them by the hundred. The worms come in many colours, can be reused, and parade under the name of Polystraps.



These drawings of a new cable fitting are about half life-size.

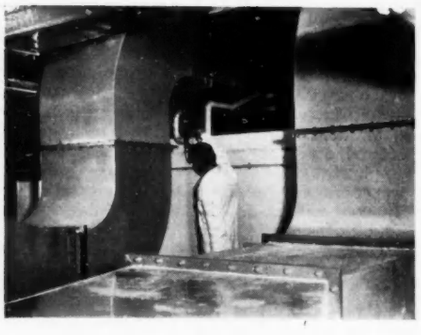
PLASTICS DUCTS

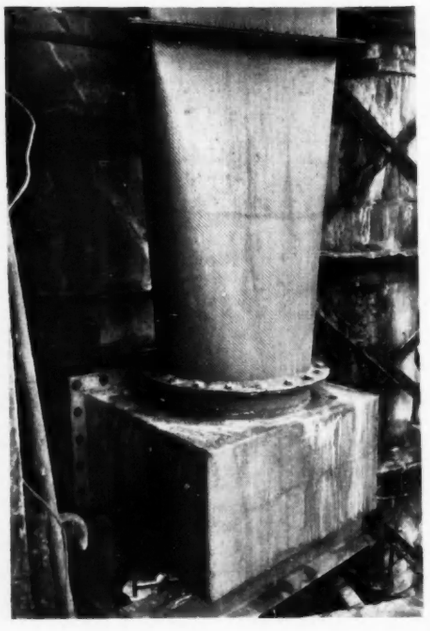
Two of the many uses of plastics for ventilating plant and fume ducts are shown here. The choice of which plastics to use for any instance depends largely on the shape of the duct and the temperature, for there is little to choose between various plastics regarding chemical resistance—they are all good. Rigid pvc is readily welded, and large ducts such as the one shown can be made from sheets without moulding. The situation is the National Chemical Laboratory at Teddington, and the fabrication was performed by Rediweld Limited from Cobex rigid pvc—a product of BX Plastics Limited of Chingford. At an air extraction rate of 4,000 cu. ft per min there is no drumming, and this is claimed by the makers to be an advantage over sheet metal.

The second duct is in a thermosetting plastic—an epoxy resin system reinforced with glass fibre. Welding is here impossible, and such ducts must be made by hand lay-up on a mould to the exact required shape. Once set the reinforced plastic has high strength (thousands of lbs per sq. in) and will withstand chemicals up to quite high temperatures. The demand on this one—made by Panglass Limited of Bristol for the National Smelting Company at Avonmouth—is to carry sulphur dioxide fumes at 60° C. This is well within the performance limits of the plastic (maximum about 150° C) which was Araldite X83/8 made by CIBA.

(Right) Glass reinforced epoxy resin resists sulphur dioxide at 60° C.

(Below) Welded pvc sheet enables ducts to carry large volumes of air without drumming.





GLASS REINFORCED POLYETHYLENE

Perhaps the name of F. R. Polythene is less awe-inspiring than the title, but in either case the material referred to is a straightforward sheeting material which has high strength and which is protective. It is intended for machinery covers, especially for outdoor use, but windbreaks and cover for construction work also springs to mind as possible uses. Marketed by Swains Papercraft Limited of Buckhurstthill, Essex, the sheet is American and has a two way glass reinforcement with a $\frac{1}{4}$ in or $\frac{1}{2}$ in web.

With the latter, and a filling of polyethylene 0·004 in thick, it is over 15 per cent better in breaking and tearing strength than a 0·006 in unreinforced polyethylene sheet. It is sold either as sheet or made up into bags.

HELIUM MAY RUN OUT

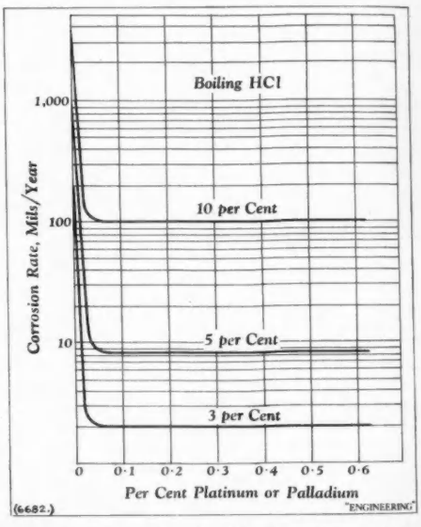
A new American plant is designed to produce 290 million cu. ft of helium a year, which will nearly double the Government's annual production of the lightweight non-inflammable gas. The site is Keyes, in Oklahoma. The new plant will employ 86 persons and will process natural gas. If results are similar to those obtained in other plants, a purity of 99·995 per cent will be consistently achieved.

Acting Secretary of the Interior, Mr. E. F. Bennett, has said that the United States " never will feel in a position of real security until a long-range, national helium-conservation plan is operating." On 28 July, the Department of the Interior renewed its request for congressional legislation that would enable it to carry out a national helium-conservation programme. Most of it now goes up the stack when natural gas is burned and some 32,000 million cu. ft of helium could be saved from this source. If the loss continues unabated and demand increases as expected, the helium-bearing gas sources in the United States could not be expected to be adequate after 1980-1985.

TITANIUM RESISTS REDUCING ACIDS

Titanium shows its good corrosion resistance in oxidising environments where a stable oxide film is formed. It will, for instance, withstand boiling nitric acid. It is not so good, however, in reducing environments such as hydrochloric and sulphuric acid.

Now, two developments promise to make titanium outstanding even for these acids. ICI (Metals Division) have been one company to show that a thin film of platinum on titanium changes the surface potentials in such a way that corrosion is reduced; this has been widely publicised. Union Carbide Metals Company have found that an alloying addition of a small amount of platinum or palladium also reduces the corrosion rate. This is illustrated, and it can be seen that an alloying addition of 0·1 per cent has the maximum effect in boiling hydrochloric acid of 3 to 10 per cent strength.



The addition of palladium is said to have no effect on the mechanical properties of titanium, and the alloy can be hot or cold worked without difficulty.

BRASS IS HOT PRESSED

The author of a book called *Hot Brass Pressing* is a member of the staff of the Copper Development Association. This organisation also publish it. It comes in a cover of the appropriate colour—brassy—and the author soon shows that he has understood the art of pressing curvaceous blondes on to the handles of paper-knives. *Hot Brass Pressing* contains details of the properties of the materials and gives hints on design.

A section on forging processes, with which the book ends, has been kept very short since the published literature on forging is rather more extensive than that on hot pressing.

Copies may be obtained from the Association at 55 South Audley Street, London, W1.

Removal and Storage of Concrete Blocks

Details are given here of a transporter, designed for use in an atomic power station, to move and position concrete shielding blocks in packs of five weighing 125 tons all told.

Messrs. Robert Hudson Limited, Light Railway Engineers, Meadow Lane, Leeds, have recently designed and made for the United Kingdom Atomic Energy Authority Research Establishment, Harwell, two special transporters for the 7 GeV proton synchrotron project. They will be used in the experimental area adjacent to the magnet room for moving (and positioning) concrete shielding blocks in packs of five (total weight 125 tons).

The transporter consists of an electrically-powered traction unit coupled to suitable trolleys fitted with hydraulic lifting jacks and running on steel rails. In the interests of safety the trolleys are fitted with manually-operated emergency stop switches. In addition these (and the traction units) have automatic switches to prevent overrunning the limits of longitudinal travel.

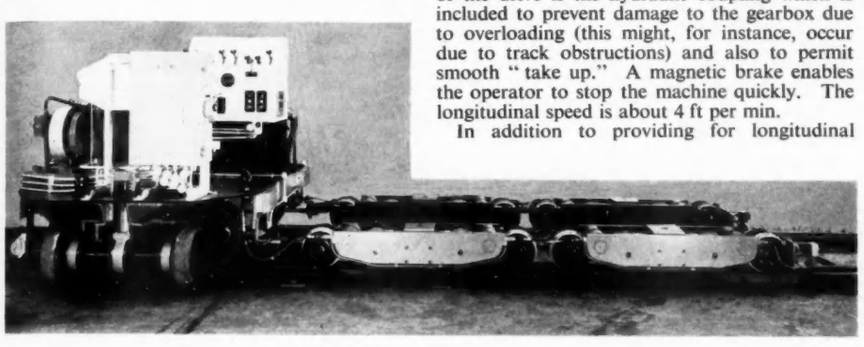


Fig. 1 The trolley unit consists of four trolleys (arranged in two pairs) connected by steel drawbars.

The arrangement of the transporter is shown in Fig. 1, from which it will be seen that the trolley unit consists of four trolleys (arranged in two pairs) connected together and to the power unit by steel drawbars. The traction unit carries all the controls for the hydraulic and electrical gear as well as the motors and pumps.

Fig. 2 shows the trolleys coupled in tandem. Each runs on eight solid-forged steel wheels designed for parallel roller bearings and is fitted with an hydraulic jack of 62½ tons capacity (double the required working load). Pressure is supplied to the jacks through flexible hoses with self-sealing couplings, to enable the traction unit and trolleys to be disconnected without loss of fluid. The jacks are of the single-acting type with self-aligning caps, with a large bearing area to minimise pressure on the concrete blocks.

All electric and hydraulic services are duplicated on the trolleys so that it is possible to connect the traction unit to either end of the trolley assembly. The emergency stop switches and limit switches are mounted on a common bracket (see Fig. 3) which permits their fitting at either end of the trolley assembly.

The framework of the tractor unit is of heavy construction carried on eight wheels mounted on two axles. Both axles (fitted with spherical roller bearings running in cast steel axleboxes) are driven, the wheels being fitted with solid rubber tyres to ensure sufficient adhesion. The wheels run on the same rails as the trolley units and the outer wheels have steel flanges. Tractive effort is provided by a 2 h.p. electric motor through a 2,000 to 1 double worm reduction gearbox, the final drive and that between the two axles being by Duplex roller chain. A feature of the drive is the hydraulic coupling which is included to prevent damage to the gearbox due to overloading (this might, for instance, occur due to track obstructions) and also to permit smooth "take up." A magnetic brake enables the operator to stop the machine quickly. The longitudinal speed is about 4 ft per min.

In addition to providing for longitudinal movement it is necessary to move the power unit laterally. To permit this a further set of four wheels is provided. These are fitted with rubber tyres and, when not in use, are retracted clear of the floor. They are brought into operation by hydraulic jacks operating downwards on the centre of the axle, that raise the whole vehicle clear of the ground. The drive for these traversing wheels is by a ½ h.p. electric motor through reduction gear units and V belts, giving a lateral speed of about 12 ft per min.

To allow the unit to be turned about its vertical axis, a precision ball bearing turntable is incorporated underneath the frame. This is operated by a hydraulic jack which can raise the complete unit clear of the ground so that it can be turned manually on the turntable as a base (Fig. 4). An electric limit switch renders all the transmission motors inoperative when the turntable is lowered.

Electric power for the various motors is carried by a screened trailing cable which is automatically wound or unwound by a reeling drum fitted on the chassis. The mechanism of the drum includes a pair of hunting tooth limit switches to prevent damage to the cable due to over or underwinding. As in the case of the trolleys, a pair of limit switches is built on the end of the vehicle to control the extent of longitudinal travel.

The electric transmission motors are operated by push-button controls and the hydraulic jacks by lever operated valves, all controls being fitted into the panel shown on the traction unit. By a special arrangement of the hydraulic controls the four jacks on the trolleys (used for lifting the load) can be operated individually or in pairs. This is done by throwing a lever which couples or uncouples the valve operating spindles to make sure that the blocks are lifted evenly and that any tilt is corrected at once.

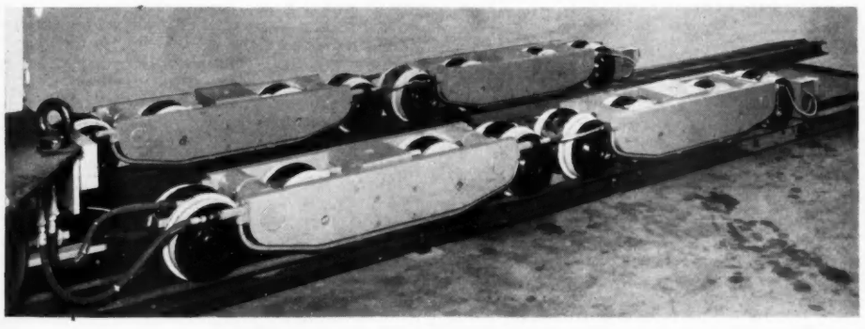


Fig. 2 Each has eight steel wheels designed for parallel roller bearings and an hydraulic jack.

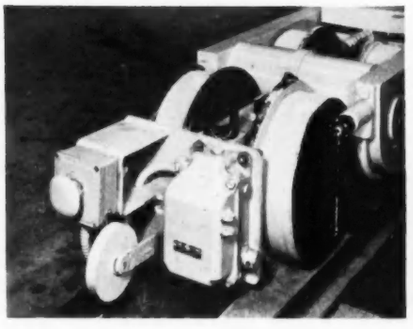


Fig. 3 Stop and limit switches on a bracket.

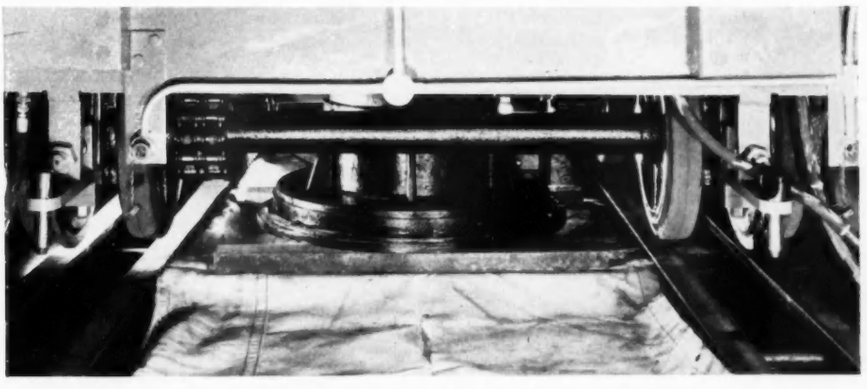


Fig. 4 So that the unit can be turned about its vertical axis, there is a turntable underneath the frame.

Gear Teeth with Circular Arc Profiles

The Novikov system of gearing has teeth with circular arc profiles instead of involute form. It is being developed in the USSR, and experiments show that for some applications it is better than the involute system.

By D. C. Johnson, M.A., A.M.I.Mech.E.
Professor of Mechanical Engineering, Leeds University

It is usual to begin the description of a toothed gearing system with a diagram like Fig. 1. Here A and B are the intersections of the wheel axes with the plane of the paper and P the intersection of AB with the common normal to the tooth surfaces at the point of contact. As is well known, the ratio AP : PB determines the instantaneous velocity ratio between the wheels. If motion is to be transmitted uniformly, P must remain fixed as the tooth profiles move. With involute gears the common normal itself remains fixed; with cycloidal gears the normal moves, but P remains fixed.

In order to understand the Novikov system replace Fig. 1 by Fig. 2. The gear ratio is again AP : PB and the two arcs drawn through P are therefore arcs of the pitch circles. The two semi-circles (with centres X and Y) are of equal radius and so placed that, when the pitch circles roll together, they coincide at the instant their centres are at the pitch point P. If the

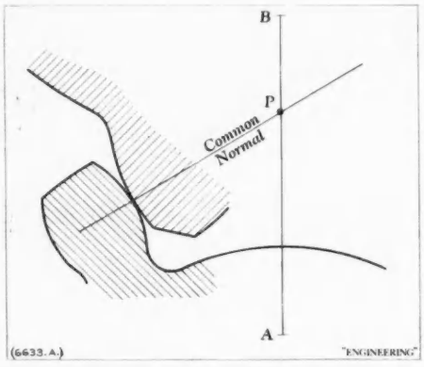


Fig. 1 Shows two conventional gear teeth in mesh.

semi-circle centred on X is taken as a semi-circular notch cut in the wheel disc and the semi-circle on Y as a tooth projecting from the other wheel, then, as motion proceeds, this tooth will instantaneously touch the whole of the inside of the notch when Y reaches P. At this moment common normals from all points on the tooth surfaces pass through P. In this position the teeth are therefore transmitting motion with the correct velocity ratio and are in contact, not at a single point, but along the full length of the profile line. If a pair of gears have teeth with this transverse profile (and the gears are helical and the helix angle suitably chosen) they will transmit continuous motion with a constant angular velocity ratio.

This is the basis of the Novikov system. Whereas in involute spur gears the line of contact is parallel to the shaft axes and sweeps over the tooth surfaces from root to tip on one wheel (and from tip to root on the other), the line of contact in Novikov gears always lies in a plane perpendicular to the shaft axes and sweeps along the tooth from one side of the wheel to the other.

In practice the tooth sections are usually not

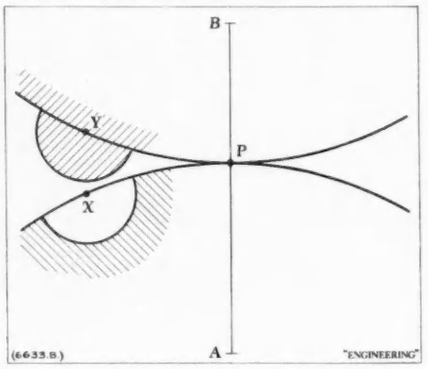
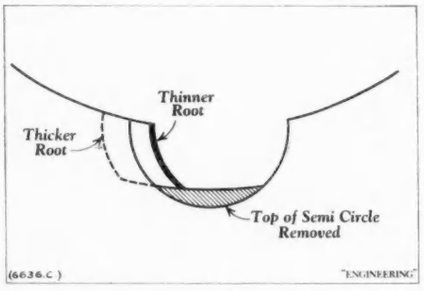


Fig. 2 (above) Semi-circles in the Novikov system.

Fig. 3 (below) Top of semi-circle cut-off tooth.



completely semi-circular. Firstly, the round top of a semi-circle does not transmit any appreciable load, because of the unfavourable pressure angle. The semi-circles can therefore be cut off, as shown by the shaded area in Fig. 3. Secondly, there is no reason for the root thickness of a convex tooth to be the same as the diameter of the circular profile. The tooth can be thinner (as shown by the thick line of Fig. 3) or thicker (as shown by the dotted lines) because the two flanks of a tooth section do not have to mesh simultaneously. Thirdly, the equal radii of the convex and concave profiles can only be used for one particular value of the centre distance and variations of this value (due to manufacturing tolerances, thermal expansion or elastic deflection) would prevent the teeth from meshing correctly. The convex teeth are thus made with a slightly smaller profile radius than the concave teeth.

Teeth designed like this (and with suitable corner radii and chamfers) appear in Fig. 4 but there is another possibility that may be better for some applications. The teeth of Fig. 4 are entirely inside that of the left-hand wheel. That is, the right-hand wheel is all addendum and the left-hand wheel all dedendum. It is possible, however, to have some addendum and some dedendum on each wheel, as in Fig. 5. The teeth on the two wheels have a similar shape, each having a convex portion above the pitch circle and a concave portion below it. In the position shown in Fig. 5, the concave part (dedendum) of the tooth A, is meshing with the convex part (addendum) of B_1. The other parts of these two profiles meshed at a position on the other side of the pitch point which the teeth A_2 and B_2 are just about to reach. A transverse section therefore carries load twice during its passage through the meshing region: first, when the concave dedendum B_2 of the driver touches the convex addendum A_2 of the follower (this happens before these tooth surfaces pass the pitch point); and secondly, when the addendum of the driver B_1 touches the dedendum A_1 of the follower, on the other side of the pitch point.

To arrive at a suitable design for a pair of Novikov gears it is necessary to choose these parameters:—the tooth profile radius; the tooth height; the tooth thicknesses; the ratio between the convex and concave profile radii; and the helix angle.

Photocopies of the full paper, of which the above is a digest, are obtainable from the Publisher, ENGINEERING, *36 Bedford Street, London, WC2, price 25s, post free. Orders should be accompanied by a remittance.*

Fig. 4 Right-hand wheel is all addendum and the left-hand all dedendum.

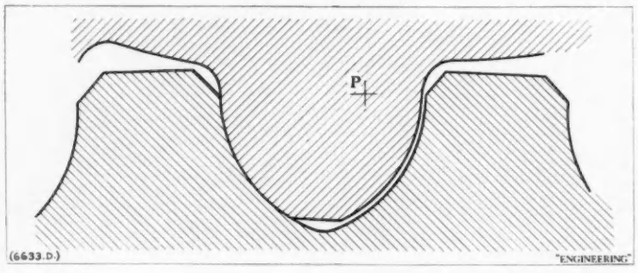
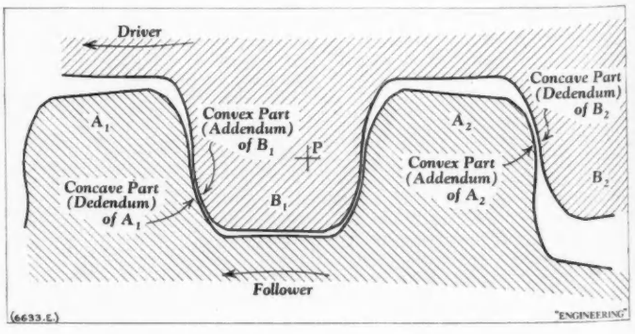
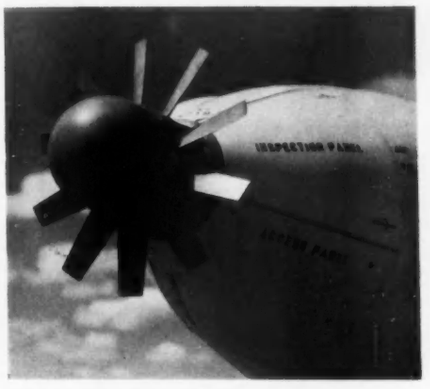


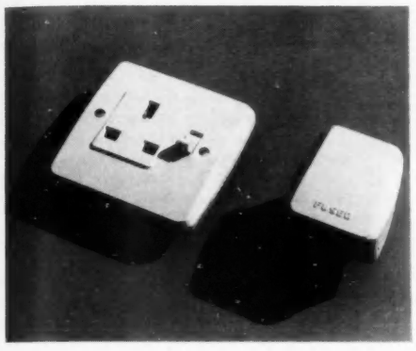
Fig. 5 There is some addendum and some dedendum on each wheel here.



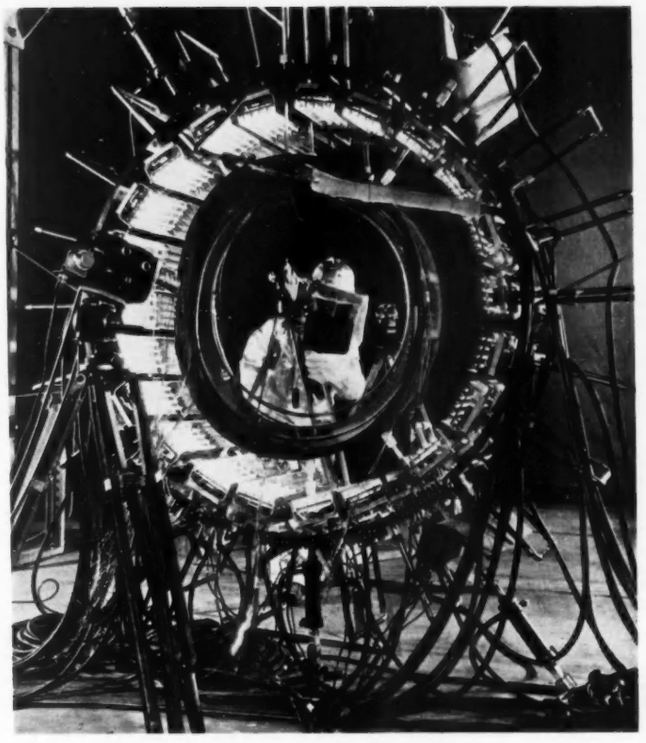
(Above) *The Saunders-Roe P531 helicopter is a general purpose machine designed to take a 1,000 s.h.p. engine. A Mk. 2 version is shown here with a Blackburn A129 free-turbine engine of 970 s.h.p.*



(Above) *The ram air turbine drive of the Mk. 20 refuelling pack made by Flight Refuelling Limited.*



(Left) *13 amp switch socket and fused plug top made by S. O. Bowker Limited.*



(Right) *Thermal fatigue properties of the rocket ship X-15 were tested in this rig.*

(Left) *Stainless steel garden shears designed by Ward and Payne Limited.*

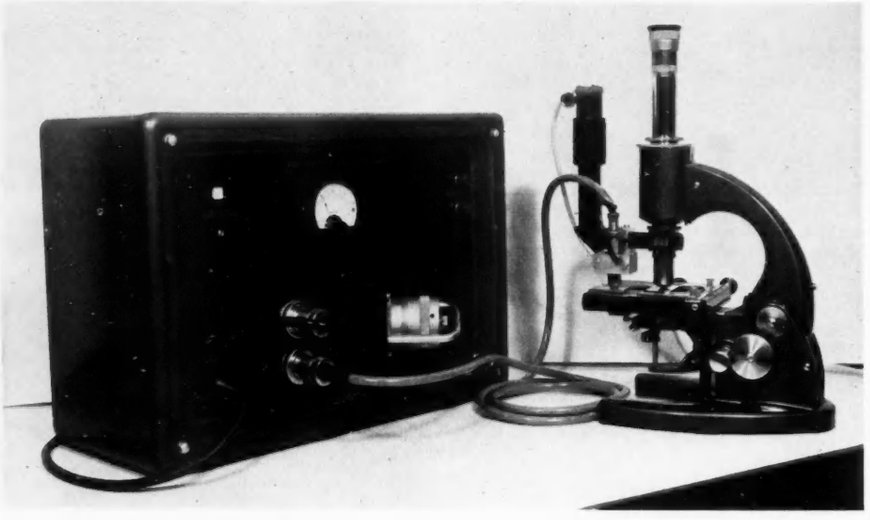
(Below) *Lightweight air-circulation ovens (designed by GEC Limited) on the BOAC Comet 4.*

(Below) *The new Ford Anglia's shape has been aerodynamically designed after a series of wind-tunnel tests. The reverse rake rear screen (a distinctive feature) gives more passenger room in the back seat.*

PRECISE MEASUREMENT BY MICROSCOPE

The finer details that can be resolved with a conventional microscope are usually too small to be measured accurately with calibrated screw adjustment systems. Microscopes consequently seldom have measuring facilities.

This limitation can be overcome by attaching to the microscope a non-contacting probe connected to the B721 Electronic Micrometer (The Wayne Kerr Laboratories Limited, Chessington, Surrey). The attachment is so arranged that any movement of the microscope tube (relative to the object viewed) results in the same movement of the probe relative to a metal plate. This distance is measured on the electronic micrometer which, for a distance of 0·001 in, provides a discrimination of 1 part in 1,000. No contact with the specimen under observation is necessary and, since there are no moving mechanical parts, a high order of accuracy can be maintained for years. Probes can readily be attached to any type of microscope and the method can be used for measurements vertically or along any axis in the horizontal plane.

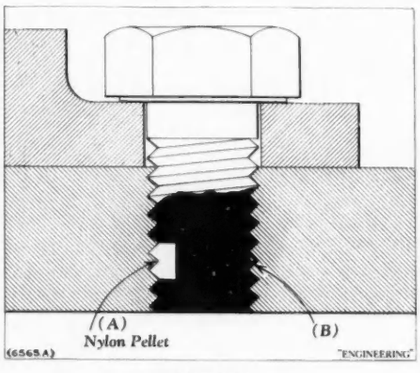


The first application of the new technique has been to measure the depth of etch in photogravure printing plates. Using a microscope with a Baker interference objective, Wayne Kerr engineers have succeeded in measuring the mean depth of cells and the depths at various points within one cell.

Repeated measurements on one cell (with a maximum depth of 0·002 in) gave results with a standard deviation of only five millionths of an inch. No particular skill is required to do this.

Further applications in metallurgy, crystallography and biological work will extend the usefulness of any microscope from a purely observational tool to one for precise measurement.

NYLON PELLET POSITIVELY LOCKS THREADS



SCREW

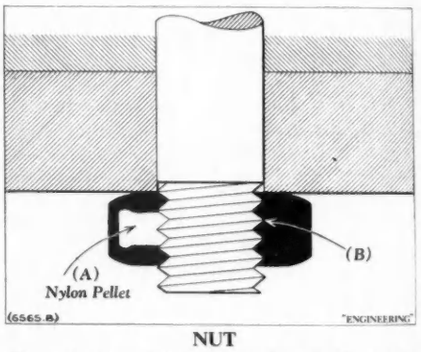
The nylon plug is normally positioned 2 or 3 full threads from the end of the screw, but may be located elsewhere in certain cases.

The locking element in the patented GKN Wedglok principle consists of a tough, resilient nylon pellet, inserted in the body of a nut, bolt or screw (see illustrations).

The pellet (which projects slightly above the crest of the thread) has a spring-like wedging action which grips the threads tightly. This creates strong metal-to-metal contact of the mating threads.

The resilient pellet (A) sets up lateral thrust and wedges the mating threads together (B). Locking is positive all the locking action being on the threads. When the Wedglok fastener is removed the plug returns to its original shape and so the fastener can be used again.

Some of the advantages claimed are that: the parts will not work loose under vibration or stress reversal; lockwashers or safety wiring are not needed; the tensile strength is not reduced; the locking action is unaffected by moisture, normal temperatures or solvents; the nuts do not have to be assembled in one particular way and so can be fed automatically.



NUT

The nylon insert is positioned centrally in one flat of the nut.

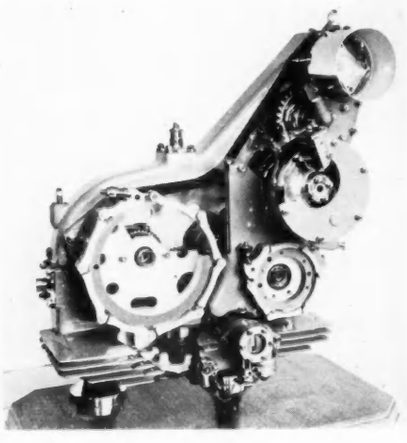
Wedglok is manufactured under licence by Guest Keen and Nettlefolds (Midlands) Limited, Heath Street, Birmingham 18.

AIRCRAFT ACCESSORY GEARBOX

This gearbox is one of four carried on the Vickers "Vanguard" aircraft. Its function is to provide mounting faces for the various aircraft accessories (which are driven through gears and quills), the necessary engine power being transmitted by the gearbox drive.

The box consists of a high-strength, light-alloy main casing and a front cover containing trains of spur gears and drives for operating the various accessories. The final drive to each accessory is provided by a quill with a safety shear neck, to protect the gearbox from damage if the accessory seizes. In the gearbox there is a Dunlop brake unit, operated by the aircraft hydraulic system. This unit comes into use when its associated engine is shut down and the aircraft exit door is opened.

The gearbox drive is of the double universal joint type, in order to compensate for any minor errors in alignment between engine and gearbox. Axial movement is allowed for because the serrated shaft (to which the gearbox drive is bolted) is free to slide in the serrated input drive shaft of the gearbox. A gear-type oil pump in the gearbox is driven through a bevel gear and pinion. Pressure oil is delivered (via oilways in the main casing and front cover) to jets which direct the oil to the various gears, drives and quills. Pressure oil is also fed to the cabin supercharger and the alternator. There is a relief valve in the casing. Oil is supplied through a Lockheed pressure filler, and the level can be visually checked. Oil pressure test connections are provided on the gearbox, and a centrifugal breather permits satisfactory breathing under all flight conditions. The box is made by Rotol Ltd.



'Curved' Lighting at Hong Kong Airport

Mountainous country and shortage of land made the construction of Hong Kong's new airport difficult. A unique lighting system permits 24 hour operation, even in bad visibility.

Hong Kong's new Kai Tak Airport has been designed to be operational 24 hours a day, even in bad visibility, which was impossible on the old site, owing to limited radio and visual aids. Since land is at a premium, the new runway, 8,340 ft long, has been built on an artificial promontory, 795 ft wide, jutting into the sea from Kowloon. This involved the moving of over 20 million tons of soil and the paving of some 60 acres of runway and taxi tracks, all to a strength sufficient for aircraft of up to 400,000 lb all-up weight. The airport is being equipped with all the latest ground-to-air aids, including long range surveillance radar, short range approach radar, and instrument landing equipment.

The approach and runway lighting, supplied by the General Electric Company Limited, London, WC2, and installed by their associate, the British General Electric Company Limited, Hong Kong, was designed by Preece, Cardew and Rider, London, in conjunction with the Hong Kong Department of Civil Aviation. Both approaches and the runway are equipped with a dual system of lighting, low intensity for normal conditions and high intensity for bad visibility. The civil consultants were Scott and Wilson, Kirkpatrick and Partners (Hong Kong).

To the north west, nearby hills prevent a normal direct approach to runway 13, and aircraft have therefore to follow a curved line of approach lights, the only one of its kind in the world. This approach passes over a densely populated part of Kowloon city, and in places the lights have had to be mounted on structures spanning buildings and streets.

Aircraft approaching from the west start their let-down procedure over the West Lamma Channel, and make a right hand turn over Kowloon to land on runway 13. To help pilots align their aircraft on the correct approach flight path, a green flashing beacon has been erected on a hill near Tai Hang Tung, about 4,000 ft from the beginning of the north west approach lighting system.

This system consists of a 3,510 ft line curving on an arc of a circle designed to conform to a 'rate one turn' of an aircraft flying at 140 knots (that is, a turn in which the aircraft changes course at a rate of 3° per sec.). The approach is then straight and in line with the runway centre line for the remaining 2,800 ft to the threshold bar. Lights are spaced 438 ft apart on the curved section of the approach and 200 ft apart on the remainder. Crossbars of lights at the start (No. 4) and finish (No. 3) of the curved section and at 2,000 ft (No. 2) and 1,000 ft (No. 1) from the threshold help the pilot to judge the horizontal position of his aircraft and, since the final three bars decrease in width towards the runway, also give a rough indication of height.

Part of the approach lighting at Hong Kong Airport is visible on the right.

On the curved section of the approach the high intensity lights, which have a limited horizontal beam spread, have been duplicated and angled so that they present a complete lighting pattern to a pilot passing over the location beacon. Thus, on the initial approach, from the location beacon to crossbar 4, the pilot sees a complete pattern from one set of lights, and then along the curve he sees it from the second set. To assist in the transition from one set of lights to the other the beams have been arranged to overlap.

As the end of runway 13 is close to Kowloon city the approach clearances are necessarily high, and the lights have had to be mounted on the roofs of buildings or on special structures erected for the purpose. Each of the high and low intensity patterns is connected on individual duplicate series circuits fed from separate supply sources, and are "interleaved," so that each circuit feeds alternate lights. Failure of one supply source therefore leaves the pattern in operation, but with alternate lights only.

The runway has a dual system of high and low intensity lights spaced at 200 ft intervals, and circuited in the same way as the approach lights, so that failure of one circuit only cuts out alternate lights. Elevated type lights are used, except at taxi track intersections, when inset fittings are installed. The runway lighting is white, except for the last 2,000 ft facing the approach, where yellow filters have been fitted; the two colours give an indication of range. A threshold bar of green inset lights, with wing bars of high intensity white lights for bad visibility, marks each end of the runway.

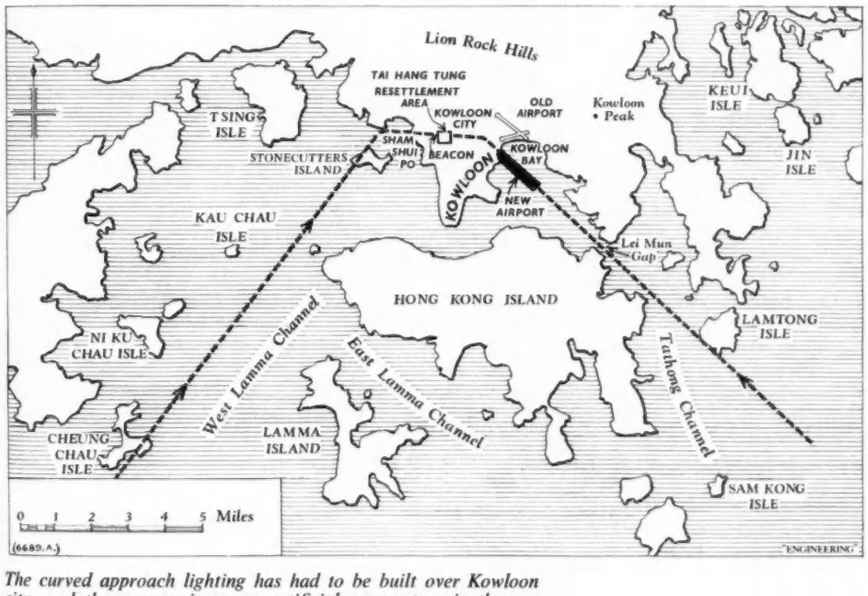
Aircraft approaching from the east fly through the Lei Mun gap, which bears directly on runway 31, and the lighting consists of a 2,000 ft line of high and low intensity fittings on piles driven into the sea bed at 200 ft spacing. Both systems are "interleaved" from separate circuits.

In poor visibility extra assistance is given to pilots by two high intensity angle of approach indicators, giving a flashing light divided into three horizontal coloured zones—red for too low, amber for too high, and green for correct approach height.

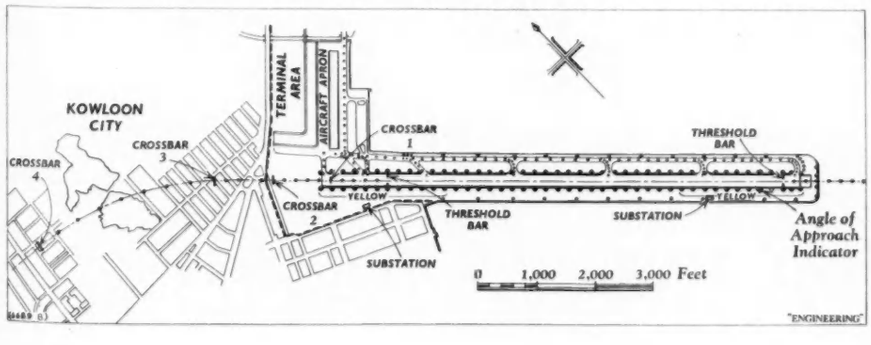
Both approach systems have high intensity lights to form lead out patterns for take off. The low intensity approach lights are omni-directional, and can be used as lead-out lights as well.

All the lighting is fed through two substations, taking current at 6,600 V, 3 phase 50 cycles and sending out a 346/200 V, 3 phase, 4 wire supply. Control is from a console in the control tower, which has a mimic diagram. Provision of the lighting system has required 675 lighting fittings of various types, 120 core miles of power cable, 100 core miles of control cable, and the making of more than 3,000 cable joints.

Because space is limited and mountains prevent a direct approach, the new airport has a curved approach path on one side.



The curved approach lighting has had to be built over Kowloon city, and the runway is on an artificial promontory in the sea.



Producing Thicker Welds in a Single Run

Joining thick plates has always been a long process requiring many welding runs. A new machine has been produced to carry out this operation by the electro-slag process. A ferro-alloy flux used with it gives satisfactory low temperature impact values.

It was three years ago when the news first came from Russia of an electro-slag welding process. This was subsequently developed in Czechoslovakia, where the patents were secured by Vus (Bratislava). The process, which is basically one of casting, had many teething troubles which virtually prevented its use in the United Kingdom, but it has now been redeveloped by Rockweld Limited who report some encouraging results.

The prime disadvantage with this method was the poor low temperature impact value that it gave under test; a disadvantage which, it is claimed, has been overcome by Rockweld. They report Charpy keyhole impact values of between 36 and 50 ft-lb from samples which were not heat treated.

The Rockweld-Vus machine (Fig.1) is designed to weld sections between 1¼ and 14 in thick. In order to carry out a weld on it, the plates are set up in a vertical plane, and the square cut edges are positioned parallel to one another with a gap in between. The gap is bridged by a pair of water cooled copper shoes which form, in effect, a mould for the molten weld metal and which also give the required contour to the finished weld. The shoes are mechanically operated so that they move vertically upwards as the weld proceeds.

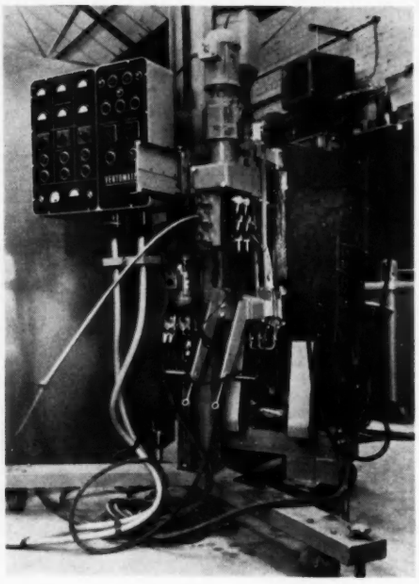


Fig. 1 Rockweld-Vus Vertomatic slag welding machine.

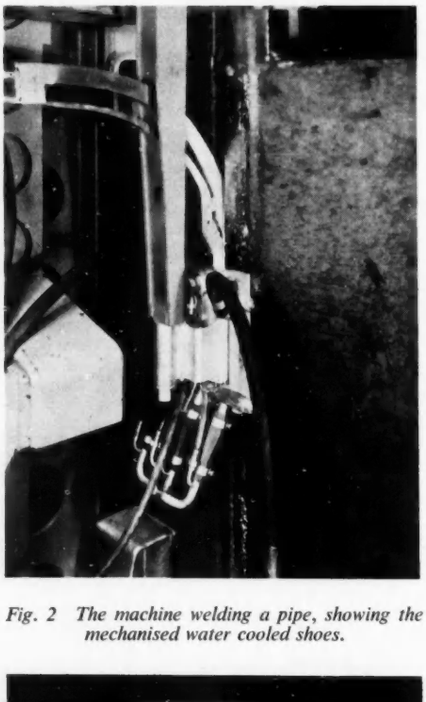


Fig. 2 The machine welding a pipe, showing the mechanised water cooled shoes.

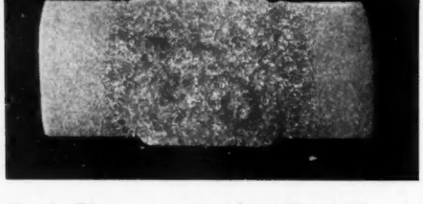


Fig. 3 The cross section of a weld carried out by the machine.

To begin a weld, a prepared block is placed below the plate edges to close the welding cavity. Granulated flux is dropped into it and a starting arc is established with the electrode wire, in a manner similar to the submerged arc process. Arc energy, however, is used only to begin with, in order to fuse the flux into the molten slag, which soon becomes, owing to its temperature, an ionised mass offering a path of relatively low resistance to the current flowing from the electrode wire to the pool of weld metal and the adjacent plate edges. Electrical energy, expended this way in the slag and weld metal, becomes the medium through which heat is maintained for the continuous fusion of the electrode wire. To obtain steady energy dissipation with thick plates, a transverse, backwards and forwards, motion can be automatically imparted to the electrode wire as it is fed to the slag. Furthermore, for very thick plates, two or three wires may be run into the pool simultaneously. As the pool of weld metal builds up, the lower part cools to form a homogeneous weld, with smooth external faces contoured by the copper shoes. Fig. 4 is a cut-away diagram illustrating the welding operation with three wires in use.

The Vertomatic, as the Rockweld-Vus machine is called, is illustrated with the welding head to the right of the vertical guides. It can, however, be just as easily set up with the welding head on the left by virtue of the symmetry of the components of the machine. The welding wire can be fed from two types of reel, either from a small one carried on an insulated bracket on the moving head, or from a larger reel mounted on separate supports. The latter method being suitable for long runs when a large quantity of wire is needed.

In Fig. 2, one of the moving shoes is shown in contact with the workpiece. This contact is maintained by pressure exerted from flexibly mounted arms. The movement of the shoes and welding nozzles and the automatic supply of flux are controlled by a set of relays operated by contacts attached to one of the shoes. This method of control is claimed to maintain a constant head of molten slag above the pool of molten weld metal.

The guides on which the nozzle head travels are carried by a tripod structure mounted on castors for easy mobility. The normal arrangement of this structure carries guides to a height of 20 ft.

The penetration of the weld, of which a typical cross section is shown in Fig. 3, is controlled by the width of the gap between the parent plates and by the voltage applied across the weld. The control equipment provides this adjustment, which can be preset or varied during operation. The transverse movement of the wire feed nozzle is also adjustable and its setting plays an important part in ensuring consistent mechanical properties and good appearance. All electrical control equipment of the Vertomatic is housed in the relay cubicle. A control panel is provided upon which are mounted the components for setting and adjusting the various functions of the machine. Welding current is normally provided by a flat characteristic transformer to give an a.c. arc.

The welding wire used in conjunction with this machine contains its own flux, rolled into it rather like the jam in a swiss roll. The flux, from which the weld derives its favourable impact strength, is rich in the ferro-alloys of manganese, silicon and titanium. Physical tests after stress relieving have shown that the mechanical properties of the weld metal correspond with those of the parent metal. Superior mechanical properties, can be obtained however, by using composite wires, the following being typical results of tests made on samples which were not heat treated.

Tensile strength .. 62,000-66,000 lb per sq. in
Yield strength .. 40,000-46,000 lb per sq. in
Elongation on 5 in diameter .. 28-32 per cent, and
Reduction of area .. 60-75 per cent.

Other grades of composite wire are under development for the welding of alloy steels and for other special purposes.

A natural comparison arises between this method of welding and the submerged arc process. The manufacturers of the machine claim that, when considering the relative fields of application of these two methods, the following practical features should be taken into account. Where thick sections are to be welded by submerged arc, elaborate and costly edge preparation is necessary, whereas with the electroslag process, a plain flame cut edge is all that is required. With the emphasis still on thick sections, slow multipass welding is an inevitable part of the submerged arc process and there is an economic limit to the thickness that can be welded. The electroslag equipment, on the other hand, requires only one setting for any particular joint, and there is virtually no limit to the

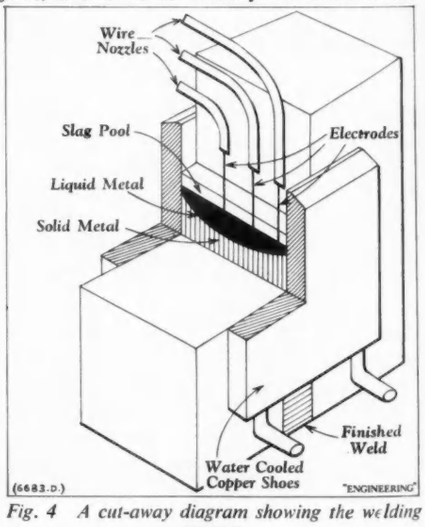


Fig. 4 A cut-away diagram showing the welding process.

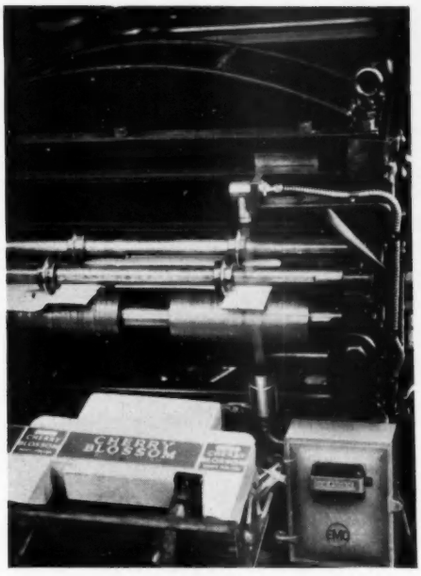
Production

COUNTING CARTONS

A simple and interesting method of counting cartons by means of a photo-electric cell has been installed in the Chertsey Road factory of Chiswick Products Limited, where the tins and cartons for Cherry Blossom boot polish are printed and manufactured.

The fully transistorised electronic counter, made by the Electronic Machine Company Limited, has been fitted to the discharge end of the carton slotter and cutter. The device, shown in the accompanying illustration, incorporates a photo-electric cell and a light head. The operation of the counter, which is reported to be particularly suitable for use in applications where vibration is unavoidable, occurs when a blank breaks the beam of light triggering off a relay which registers the count on a resetable counting head mounted in front of the electronic unit.

This method of counting is claimed to be superior to either human counting or mechanical counting; the former alternative being tedious and wasteful operation which leads to eye strains and subsequent miscount, and the latter being susceptible to vibration.



A carton blank passing through the counter, prior to falling on to the delivery table.

STEEL SPECIFICATIONS

A series of summary sheets of the British Standards for steel is being prepared jointly by the British Standards Institution and the British Iron and Steel Federation. They will be published in English, in both British and metric units, and in French, German, Portuguese and Spanish. Some 20 sheets in each of the five languages are being prepared and are being grouped so that materials for similar products are shown on one sheet. It is hoped that " the distribution of these summary sheets will encourage the use abroad of British materials." In addition, tables are being prepared showing comparisons between American, British and German steels. They will be in three parts, under the headings of carbon and low alloy steels, alloy steels, and steels generally, specified by mechanical properties.

This information is included in the annual report of the British Standards Institution.

A section of this report covers the technical work of the international organisations concerned with standardisation. This contains a brief record of the subjects under discussion, and the progress made, in the technical committees during the year ended 31 March, 1959. With regard to machine tools, the International Standards Organisation committee approved their machine tool test code, which is now being prepared as an ISO recommendation.

This is afterwards expected to become the basis for additional work in the United Kingdom on the testing of machine tools. Three draft recommendations for tool shank tapers, lathe centres and lathe tool posts were also approved.

MOBILE DEMONSTRATION UNIT

A new demonstration unit, to show other European countries some of the advances which have been made in this country in electronic machine control systems and other aids to automation, is being launched by EMI Electronics Limited.

The unit is housed on a 25 ft Commer tractor/trailer unit and will have its first showing at the Paris Machine Tool Exhibition which opened on 12 September. The trailer has been fitted out as a complete modern workshop. There is a programmers' office where punched tape is prepared to produce a wide range of workpieces, ranging from simple two dimensional templates to three dimensional dies. Dominating the workshop area is a large Kearney and Trecker milling machine of new design which is controlled by the tape.

Another industrial aid with the unit is closed circuit television in its most up-to-date form, a tool now being used by an ever increasing number of organisations in order to give management finger-tip control. Future plans for the unit include tours behind the Iron Curtain.

Concluding **Producing Thicker Welds**

thickness of plate that can be welded. Some of the other advantages claimed are: the electroslag process introduces no problems of slag removal or surplus flux recovery; homogeneous heat distribution throughout the depth of weld by the electroslag method eliminates the distortion difficulties which accompany submerged arc work and residual stresses are low; and finally, considerable savings in manpower and supplies are claimed over automatic welding. An example of this last claim is reported to have occurred in the welding of two plates, 13 ft long and 2¾ in thick. This operation took only 4 hours, whereas the equivalent time required with normal preparation and hand welding by four operators was one week.

Marketing

Finding Out What to Make

Motivation research is a phrase with drawing power. So much so that when its high priest in Britain, Mr. Harry Henry, director of the research department of McCann-Erickson Advertising Limited, London, held a press conference to launch that department as a new market research company, Marplan Limited, under his managing directorship, although 60 seats were set out 100 journalists turned up.

Mr. Henry proclaims the sovereignty of the consumer, with his, or more often her, final decision—to buy or not to buy. General agreement may well not be given to his suggestion that what one manufacturer can do, another can do just as well if he gives his mind to it. And there are qualifications to his belief that the problem of manufacturing new or established products is nothing like so important as the problem of selling them.

An echo of the Federation of British Industries' booklet *A Survey of Export Trade Facilities* (ENGINEERING, 15 May '59, p. 631) which stressed using market research, comes from Mr. Henry. Summarising the situation in his own fashion he sees the problem before British industry, at home as well as abroad, as no longer one of selling what it makes but of making what can be sold. British firms who want market research help abroad from the new company will be able to get the answers from associate companies. Marplan, Germany, was set up in the Federal Republic earlier this year.

Will the lonely genius with an idea years ahead of his time become swamped in all the complexity of methods borrowed from the social sciences, statistics, psychology and anthropology? The market research men do not think so. The more responsible do not see themselves as all-powerful oracles.

The opening of one Marplan publication is highly relevant. It says: " No research operation, however painstaking or skilful, can supplant management judgment in its function of taking decisions relative to the conduct of business enterprises." Market research can ask questions and analyse answers. Motivation research can look into why a housewife buys a washing machine of this style and not that.

But in the terse words of Mr. Henry—the function of management is to manage.

Exports to Canada

A 40 per cent increase in our exports to the United States of America from January to August over the same period of last year is announced by the Board of Trade. The monthly rate over the eight months ran at £29,800,000 compared with £21,200,000 from January-August, 1958.

For the month of August United Kingdom exports to North America as a while were £7,200,000 down on July. Most of this drop was accounted for by the fall of £5,400,000 from the July figure in the value of exports to Canada. With only a 4 per cent increase over January-August last year, industry has failed to match there the rapid expansion achieved in the highly competitive United States market. The August fall from the July figure of exports to the United States was £1,800,000, to a total of £29,800,000. Exports to North America as a whole in August were valued at £44,400,000.

Package Deals

A nation wide network for the sale and servicing of industrial products has been established in Canada by a group of 12 companies. Known as Canmark Services Limited, it was formed to meet the needs of engineering manufacturers who are seeking " a complete ' package ' in engineering sales, warehousing, installation and servicing." It will embrace the electrical

mechanical and electro-mechanical industries.

Canmark's headquarters are in Toronto. The member companies are mainly engaged in installations, maintenance, servicing and sales of electrical and mechanical equipment for industry. Their purpose is to acquire agencies for allied lines of industrial equipment for distribution and sale across Canada. Their joint resources include some 800 employees, many of whom are professional engineers, 120,000 sq. ft of warehouse space, 40 delivery and service trucks and 75,000 sq. ft of repair shop space where they can undertake light manufacturing and assembly.

Accent on Specials

The methods of marketing small electric motors in the United States are beginning to change under the stimulus of increased competition. Considerable additional flexibility in manufacturing plant has resulted from the introduction of automation. Automatic control of machine tool operation and line production has made possible the manufacture of " specials " at a cost not greatly in excess of that of " standards." The General Electric Company of America have therefore begun a sales promotion campaign designed " to sell custom engineering by stressing the benefits of matching a motor to the pump, fan, compressor, or machine tool that it drives." The main targets of the campaign are the original equipment manufacturers.

The proportion of electric motors sold to original equipment users (OEM) has been declining steadily during the past few years. In 1955 OEM took 51·2 per cent of GE's sales of alternating current motors of 1 to 200 h.p. Equipment users who buy their motors separately from the machines accounted for 30·7 per cent. Of the remainder, 18·1 per cent was sold to distributors or resellers. In 1958 OEM's share had fallen to 48·5 per cent and that of equipment users had risen to 32·4 per cent.

By making " specials " GE expect that sales to OEM will rise, and that the company will benefit from consequent increased stability and predictability of sales.

Accent on Service

A maintenance service scheme has been introduced by Wolf Electric Tools Limited designed to maintain " peak " efficiency for their products. The contract offered covers two, three or four overhauls a year, depending on whether tools are used for continuous or intermittent production or general purpose duty. The service includes dismantling, cleaning, thorough mechanical and electrical overhaul, lubricating, renewal of carbon brushes and skimming of commutators if necessary. Earth leads are checked on full load continuity testers which pass a heavy current and will burn the cable through should it be defective. Tools are given half hour running test and insulation flash tested at 1,000 volts. Double insulated models are tested at 3,000 v. Charges, which cover all except the cost of materials used, range from 55*s* for two services a year to 110*s* for four services a year on the company's light range (machines up to and including 270 watts input on full load), and from 95*s* for two services to 190*s* for four services for their heaviest range (machines of 775 watts and over).

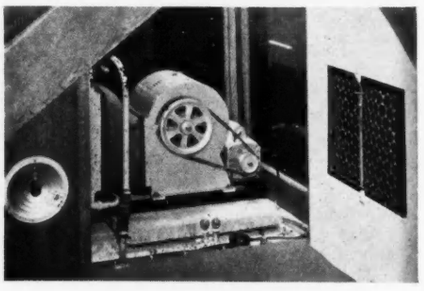
Users will be notified by their nearest Wolf service branch when servicing under contract falls due.

At Home

HOT AIR

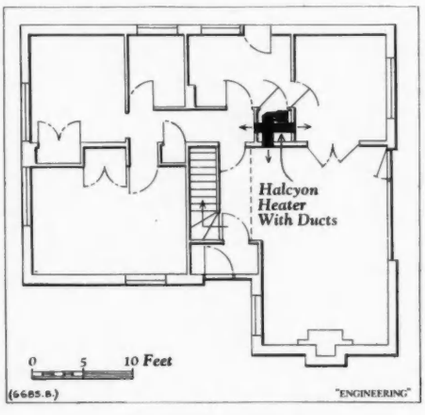
Space heating by convection offers several advantages over other means. Air can be circulated quickly, it can be directed by fans and ducts to the required points and it also supplies the movement needed to ventilate rooms and passages. Being hot there is no sensation of cold draughts.

In its simplest form, the convector has a heat source, electric element, oil or gas flame, or coal fire, round which air is allowed to pass naturally. The temperature difference supplies the means of circulation. Larger systems require some form



(*Above*) *The Lornair Stairpak fits in the waste space under the staircase.*

(*Below*) *The Halcyon unit, shown black, is gas fired and feeds into the various rooms of the house.*



of direction and a fan to distribute the air. The first type is familiar to most householders—an enormous range of oil and electric heaters is now available for warming single rooms and small areas. Less familiar to the domestic user are the larger types though these are becoming more widely used in business establishments.

A very simple arrangement is the Lornair Stairpak which works from an existing indirect hot water system. The distributing fan unit has been made to fit under the staircase, where it occupies space that is normally wasted—a 3 ft cube is sufficient. Basically it consists of a small electric motor that drives a circulating fan. The air passes over a heater which is in the hot water system and issues from a grille into the house space. When fitted under the stairs as suggested the warmed air circulates through the whole house, heating in particular the hall, landings, and passages.

In a bungalow or for special areas the Stairpak unit can be fitted in a cupboard. All that it needs are the connections to the electricity supply and to the hot water system, both of which are simple to make. It does, of course, impose an additional load on the boiler of the hot water system and this must be considered in the first instance.

A more elaborate system, but based also on a hot water installation, is the Potterton warm air unit. For this the circulating unit is placed in the roof space and ducts run from it to the various rooms. The heater is connected to the hot water system, usually by a T from the rising pipe. The air is drawn from recirculating grilles set in the ceilings or walls of the rooms and is filtered before passing over the heater. It is stated that a boiler with a rating of 44,000 Btu per hour would be large enough to supply both the normal hot water requirements and the warm air unit.

Two sizes are made, the Minor for giving background warmth in bungalows and two-floor houses of 860 to 1,000 sq. ft, and the Standard which will provide full heat for the lounge and comfortable background heat for the rest of a house of the same size. In hot weather the fans can be switched on to circulate air and give a cooling effect. Flexible ducts are used which can be run between the joists and are easy to lay. The motor rating for the Minor unit is 25 watts and for the Standard is 180 watts. The air ducts are 4 in diameter. The air filters are replaceable and can be cleaned by using an ordinary vacuum cleaner.

A heater not dependent on any outside source is the Sugg Halcyon. This has a gas burner and requires a flue for venting but otherwise needs no supply connections. The illustration shows the method of installation in a Wates Dormey house of the type being built at Crawley, Coulsdon and other places. The South Eastern Gas Board have installed many Halcyon heaters in flats and maisonettes in Sutton and Surbiton as well.

The basic heating unit measures 17 in by 12 in by 34 in high. It has a heat output of 17,000 Btu per hour, or about 5 kW. It incorporates a gas burner and a corrosion resistant heat exchanger. A silent belt-driven fan circulates the air through the exchanger. Ideally, short ducts are taken from the unit to the outlet grilles so that the warm air can be directed to such places as the lounge, dining room, hallway, etc. Each grille is provided with a damper and selector which may be operated at the grille or, alternatively, all the dampers may be operated from one position within the compartment. The return air inlet is arranged below the outlet in the most generally used room.

The heater can be fitted with a manual heat control or can be arranged to operate from a thermostat in one room. When required, a clock control can be fitted to start and stop the heater automatically for two separate periods during 24 hours.

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